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ABSTRACT

This guide describes the 1985 National Science Foundation programs. Proposals are accepted from education institutions and others; the criteria for selection of the most meritorious research projects are presented. The programs are listed by major category: (1) mathematical and physical sciences; (2) engineering; (3) biological, behavioral, and social sciences; (4) astronomical, atmospheric, earth, and ocean sciences; (5) science and engineering education; (6) scientific, technological, and international affairs; and (7) other activities. For each, information about specific programs is provided, eligibility requirements and deadlines given and sources of additional information noted. (MNS)

National Science Foundation

GUIDE TO PROGRAMS

Fiscal Year 1985

Program Changes

Any changes in NSF's fiscal year 1985 programs occurring after presstime for this *Guide* will be announced promptly by the Foundation. The NSF *Bulletin*, available from NSF at no charge, regularly publishes this and other information, including program schedules and deadlines (with updates when needed), and notices about brochures describing the various programs. To receive a copy, write to:

Editor, NSF *Bulletin*
Public Affairs and Publications Group
National Science Foundation
Washington, D.C. 20550

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1984 Catalog of Federal Domestic Assistance

National Science Foundation programs described in this publication fall under the following categories in the latest *Catalog of Federal Domestic Assistance*, issued by the Office of Management and Budget:

47.009 - Graduate Research Fellowships
47.036 - Intergovernmental Science and Technology Programs
47.041 - Engineering Grants
47.049 - Mathematical and Physical Sciences
47.050 - Astronomical, Atmospheric, Earth, and Ocean Sciences
47.051 - Biological, Behavioral, and Social Sciences
47.053 - Scientific, Technological, and International Affairs
47.057 - Minority Research Initiation
47.05[illegible] Visiting Professorships for Women
47.060 - Research Improvement in Minority Institutions
47.063 - Precollege Science and Mathematics Education

Other Information

The Foundation provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for such findings or their interpretation.

The Foundation welcomes proposals on behalf of all qualified scientists and engineers, and strongly encourages women and minorities to compete fully in any of the research and research-related Programs described in this document.

In accordance with Federal statutes and regulations and NSF policies no person, on grounds of race, color, age, sex, national origin, or physical handicap, shall be excluded from participation in, or denied the benefits of, or be subject to discrimination under, any program or activity receiving financial assistance from the National Science Foundation.

The National Science Foundation has TDD (Telephonic Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with the Division of Personnel and Management about NSF programs, employment, or general information. This number is (202) 357-7492.

Cover: *Shell fossils from ocean-bottom cores*

National Science Foundation

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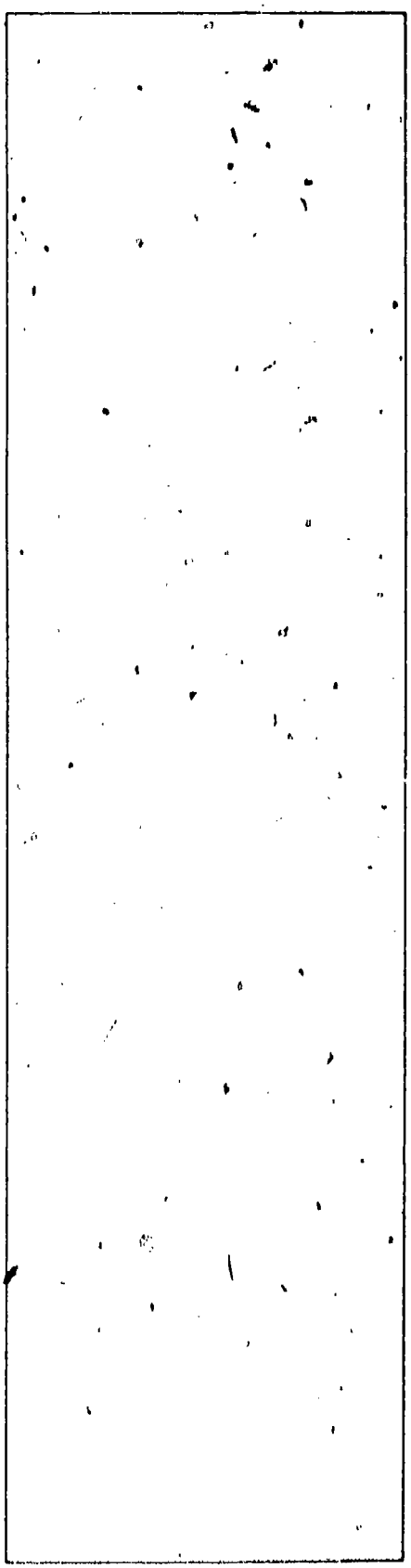

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INTRODUCTION

The National Science Foundation (NSF) is an independent agency of the Federal Government established in 1950 to promote and advance scientific progress in the United States. The Foundation does this primarily by sponsoring scientific and engineering research and by supporting selected activities in science and engineering education. NSF does not itself conduct research.

The Foundation makes awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for such findings or their interpretation.

The Foundation considers proposals for support of research in any field of science, including but not necessarily limited to: astronomy, atmospheric sciences, biological and behavioral sciences, chemistry, computer sciences, earth sciences, engineering, information science, materials research, mathematical sciences, oceanography, physics, and social sciences. Interdisciplinary proposals also are eligible for consideration.

NSF normally will not support clinical research, including research on the etiology, diagnosis, or treatment of physical or mental disease, abnormality, or malfunction in human beings. Using animals or animal models of such conditions and developing or testing drugs or other procedures to treat them also generally are not eligible. NSF does not normally support technical assistance, pilot plant efforts, research requiring security classification, the development of products for commercial marketing, or market research for a particular product or invention.

The National Science Board is the policymaking body of the National Science Foundation. Its 25 members, including the Director of the Foundation, are appointed by the President, with the consent of the Senate. The Board approves new Foundation programs and grants or contracts requiring a total commitment of more than $2 million or an annual expenditure of more than $500,000.

Proposals will be assigned to the most appropriate NSF division or office for review. Before they submit proposals, all applicants should contact program officers for current information and other help. An organization chart showing major program areas is at the end of this guide.

In deciding which proposals to support, the Foundation relies heavily on the advice and help of advisory committees, outside reviewers, and other experts to ensure that NSF reaches fair and

knowledgeable judgments. These scientists, engineers, and educators come from colleges and universities, nonprofit research and educational organizations, industry, and other Government agencies.

Most proposals come to NSF from educational institutions and other organizations rather than from individuals. However, individuals may submit proposals under special circumstances; check this guide and the appropriate program brochures or contact the program of interest for details.

The Foundation welcomes proposals on behalf of all qualified scientists and engineers and strongly encourages women, members of minority groups, and the handicapped to compete fully in all of its programs.

The Foundation also accepts proposals for basic and applied research from commercial firms, and it especially welcomes those from small businesses that have strong capabilities in scientific or engineering research. However, NSF does not wish to substitute Federal support for normal commercial investment in research or to compromise the role of educational institutions, where research makes a special contribution to science and engineering education. (For information of interest to small businesses see chapter 7, "Other Activities.")

The Foundation encourages collaboration between industry and university researchers, and between industry and State and local governments. Similarly, broader efforts through industry associations, groups of companies, or professional societies may be supported. Contact the appropriate program for information and guidance before preparing such a proposal.

Awards may be made in response to both solicited and unsolicited proposals. Normally, those that are not solicited require cost-sharing or joint funding between NSF and the awardee(s). Awards for solicited proposals may provide for payment of all costs. Proposals in response to specific program announcements are considered solicited only when the announcement so indicates.

Experimental, developmental, or research projects supported by NSF under awards to profit and nonprofit organizations will contain provisions consistent with Sections 202-204 of Title 35 of the United States Code (commonly called the Bayh-Dole Act), the Presidential Memorandum of 2-18-83, "Government Patent Policy," and the Foundation's patent regulation published as 45 *Code of Federal Regulations*, Part 650 —unless the Foundation determines that some other provision would better serve the purposes of the Act or the interests of the United States and the general public.

The National Science Foundation looks forward to using and integrating the resources of all institutions in the support of science and engineering and their contributions to the society and the Nation.

CRITERIA FOR THE SELECTION OF RESEARCH PROJECTS

In order to provide for the fair and equitable selection of the most meritorious research projects for support, the National Science Foundation has established criteria for their review and evaluation. These criteria are meant to be applied to all research proposals in a balanced and judicious manner, according to the objectives and content of each proposal. Four criteria for the selection of research projects by the National Science Foundation are listed below, together with the elements that constitute each criterion.

1. *Competent performance of the research*—This criterion relates to the capability of the investigator(s), the technical soundness of the proposed approach, and the adequacy of the institutional resources available.

2. *Intrinsic merit of the research*—This criterion is used to assess the likelihood that the research will lead to new discoveries or fundamental advances within its field of science or engineering, or have substantial impact on progress in that field or in other scientific and engineering fields.

3. *Utility or relevance of the research*—This criterion is used to assess the likelihood that the research can contribute to the achievement of a goal that is extrinsic or in addition to that of the research field itself, and thereby serve as the basis for new or improved technology or assist in the solution of societal problems.

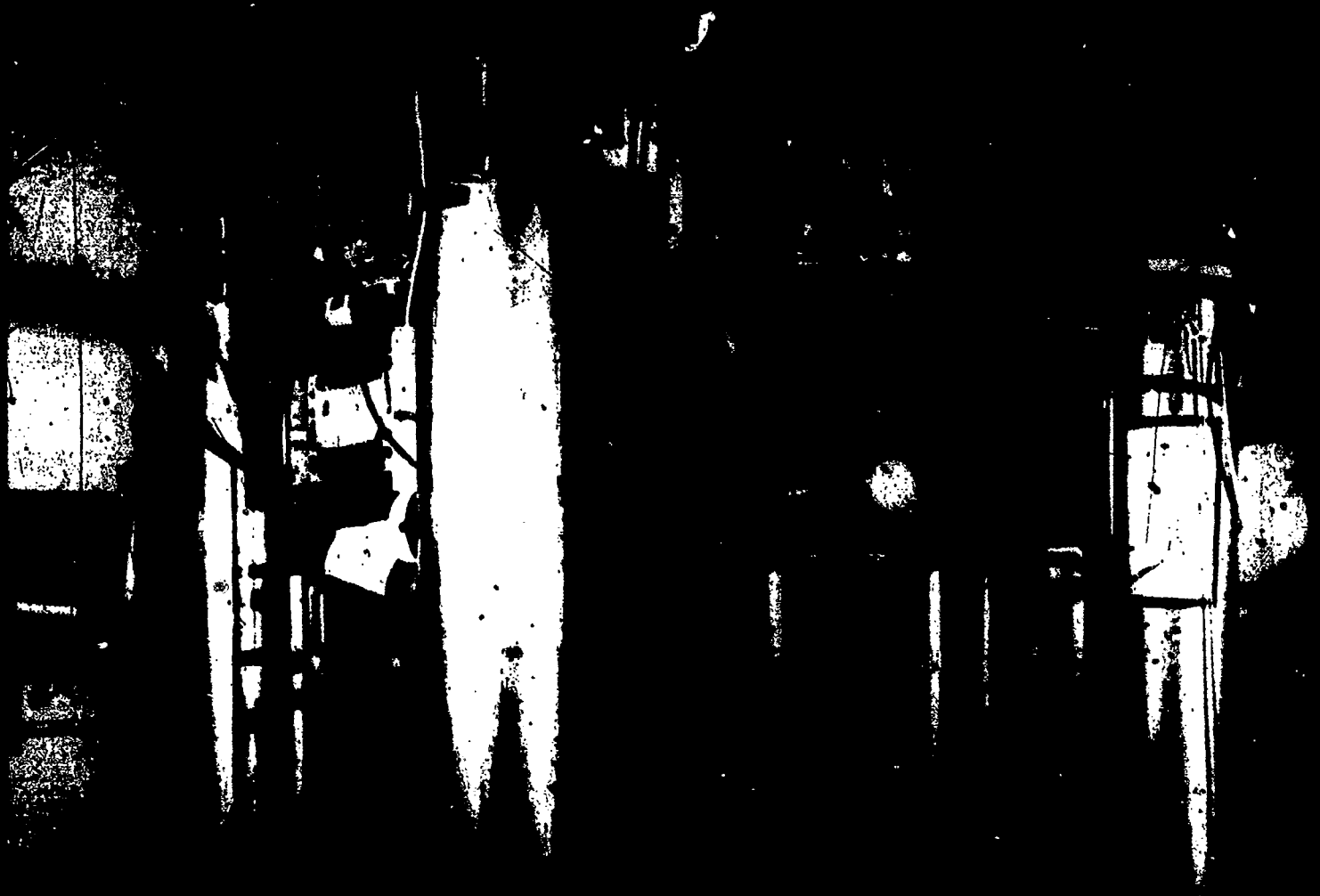
4. *Effect of the research on the infrastructure of science and engineering*—This criterion relates to the potential of the proposed research to contribute to better understanding or improvement of the quality, distribution, or effectiveness of the Nation's scientific and engineering research, education, and manpower base.

Criteria (1), (2), and (3) constitute an integral set that is applied in a balanced way to all research proposals according to the objectives and content of each proposal. Criterion (1), competent performance, is essential to the evaluation of the quality of every research proposal. The relative weight given criteria (2) and (3) depends on the nature of the proposed research. Criterion (2), intrinsic merit, is emphasized in evaluating basic research proposals, while Criterion (3), utility or relevance, is stressed in evaluating applied research proposals. Criterion (3) also relates to

major goal-oriented activities that the Foundation carries out, such as those directed at improving the knowledge base underlying science and technology policy, furthering international cooperation in science and engineering, and addressing areas of national need.

Criterion (4), effect on the infrastructure of science and engineering, permits the evaluation of research proposals in terms of their potential for improving the scientific and engineering enterprise and its educational activities in ways other than those encompassed by the first three criteria. Included under this criterion are questions relating to scientific and engineering personnel, including participation of women and minorities; the distribution of resources with respect to institutions and geographical area; stimulation of quality activities in important but underdeveloped fields; and the use of interdisciplinary approaches to research in appropriate areas.

Any specific criteria that apply to individual programs, while falling within the general criteria presented in this section, are contained in relevant program announcements or solicitations.



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MATHEMATICAL AND PHYSICAL SCIENCES

Support of research projects in this area is aimed at developing a fundamental understanding of the physical laws that govern the universe. Research results provide the knowledge basic to the future technological developments upon which our economic and social well-being depends. Those results also form much of the intellectual underpinning for the biological and behavioral sciences and engineering, and they provide many of the research instruments and techniques needed for progress in those fields.

Projects are supported across the whole spectrum from basic to applied research. Support may also be afforded for research workshops, symposia, conferences, the purchase of scientific equipment for research purposes, and construction of specialized research facilities.

To give reasonable assurance of long-term support for continuing projects of high scientific merit, funding may be provided for periods of up to 60 months in annual increments, contingent upon the availability of the funds and satisfactory progress of the research. Most support is for periods of 24 to 36 months.

Before submitting a proposal for research support, consult the brochure *Grants for Scientific and Engineering Research* (NSF 83-57) for guidance in preparing the application. The brochure shows a recommended format, but standard application forms are not required.

Eligibility

Scientists initiate research proposals, which are usually submitted on their behalf by their employing institutions. The Foundation welcomes proposals by organizations on behalf of all qualified scientists and engineers, and it especially encourages those initiated by female and minority group researchers.

The most frequent recipients of support for basic scientific research projects are colleges and universities and nonprofit research organizations. In special circumstances, as noted in this *Guide*'s Introduction, grants also go to other types of institutions and to individuals. In these cases, preliminary inquiry should be made to the appropriate program officer before a proposal is submitted.

Support may be provided for projects involving one or more scientists. Awards are made for projects in a single discipline and for those that cross or merge disciplinary lines.

Mathematical Sciences

Deadlines

Submit proposals at any time. Allow at least six months for processing. Proposals to be funded in a particular fiscal year (ending September 30) normally should be received by NSF no later than December of that fiscal year.

For More Information

Contact the appropriate division director, National Science Foundation, Washington, D.C. 20550.

Areas of Research

• **Classical Analysis**—Properties and behavior of solutions of ordinary and partial differential equations; approximations and special functions; analysis of several complex variables; singular integrals, Hardy spaces and BMO; Kleinian groups and functions of one complex variable; real analysis.

• **Modern Analysis**—Historically based on the study of classes of functions endowed with special abstract geometric and algebraic properties, this research now includes linear and nonlinear functional analysis; representation theory and Lie groups; abstract harmonic analysis; geometry of Banach spaces; operator theory and operator algebras; ergodic theory and dynamics; operator differential equations; mathematical physics; and measure theory.

• **Geometric Analysis**—Finite planes, convex sets, and related geometric topics; differential geometry and its relation to Lie representation theory, to dynamical systems theory, and to global analysis and analysis on manifolds.

• **Topology and Foundations**—General topology, algebraic topology, manifolds and cell complexes; mathematical logic and foundations of set theory, including proof theory, recursion theory, and model theory.

• **Algebra and Number Theory**—Algebraic sets and their special transformations; algebraic structures such as groups, rings, algebras and fields; combinatorics and graph theory; linear algebra; algebraic geometry; algebraic and analytic number theory, including quadratic forms; the development of algebraic techniques to answer questions raised in other areas of mathematics and science.

• **Applied Mathematics**—Modeling and analysis (both analytical and computational) to obtain insightful predictions about problems arising in the physical, biological, and engineering sciences. Areas of interest include operations research; mathemat-

ical physics; systems and control theory; applied analysis; fluid, solid, and continuum mechanics; and computational mathematics and numerical analysis.

• **Statistics and Probability**—Statistics is the study of methods to collect, organize, and analyze data so as to uncover fundamental mathematical relationships among several variables. Major subfields include experimental design, parametric and nonparametric inference, robustness, decision theory, sequential analysis, multivariate analysis, and statistical computing.

Probability theory provides useful mathematical models and is the basis of statistical reasoning. It is concerned with the study of phenomena that are random or modeled as random because of incomplete understanding. Major subfields include Markov processes, probability on Banach spaces, limit theorems, interacting particle systems, applied probability modeling, and stochastic processes.

• **Special Projects**—Modes of support different from the usual research project, including, for example, working research sessions (conferences, symposia, colloquia, special years, etc.), research institutes, and the following three subprograms:

Regional Conferences. Operated by the Conference Board of the Mathematical Sciences, these conferences feature a principal speaker who gives 10 one-hour talks on a subject during a week-long session. Deadline: November 15, 1984.

Scientific Computing Research Equipment in the Mathematical Sciences. Moderate grants for computing equipment benefit groups of researchers of outstanding quality and high productivity whose work has been seriously impeded by the lack of computing facilities. Deadline: December 1, 1984.

Mathematical Sciences Postdoctoral Research Fellowships. These go to approximately 30 new fellows each year. Tenure provides a research instructorship option. The fellowships will will be offered only to persons who (1) are citizens or nationals* of the United States as of January 1, 1985; (2) will have earned by the beginning of their fellowship tenure a doctoral degree in one of the mathematical sciences listed above or have had research training and experience equivalent to that represented by a Ph.D. degree in one of those fields; (3) will have held the doctorate for no more than five years as of January 1, 1985; and (4) will not previously have held any other NSF postdoctoral fellowship.

Each applicant will be required to submit a research plan for the tenure period requested. The fellowships are designed to support neither the preparation of prior research results for publication nor the writing of textbooks.

Anticipated deadline for submitting applications is November 15, 1984.

For More Information

Contact the Program Director for Special Projects, Mathematical Sciences Division, National Science Foundation, Washington, D.C. 20550. (202) 357-9764.

*The term "national of the United States" designates a citizen of the United States or a native resident of a possession of the United States such as American Samoa. It does not refer to a citizen of another country who has applied for U.S. citizenship.

Computer Research

• **Theoretical Computer Science**—Theories of computation and formal languages; computational complexity; analysis of algorithms; theoretical models for computation; and other theoretical problems concerned with the foundations of computer science.

• **Software Systems Science**—Conceptual basis for the specification of future software systems and the necessary experimentation with such systems, including advanced programming languages and optimizing compilers; functional and relational specification; program transforming systems; systems to verify and prove the correctness of programs; study of the concurrency of operations; discovery of new algorithms and improved measures of effectiveness of known algorithms.

• **Software Engineering**—The structure and design process of computer software, especially verification, testing, portability, reliability, and human interfacing to numeric and nonnumeric software systems. Areas of emphasis include program validation and testing, software tools, and human factors in software design and use. The program also supports research in computationally oriented numerical analysis, the design and construction of high-quality portable software for scientific research, and experimental implementation where that is an integral part of the research.

• **Intelligent Systems**—Computer-based systems that have some of the characteristics of intelligence. Relevant areas include knowledge engineering, automated theorem-proving, mechanical inferencing, problem solving, pattern analysis, computer vision, natural language and speech understanding, and areas related to the automatic analysis and handling of complex tasks.

• **Computer Systems Design**—Principles of computer systems design relating to the structure of computer systems or the process of systems design. Topics include, but are not limited to, computer system architecture, distributed computer systems, integrated hardware/software systems, performance measurement and evaluation, fault-tolerant systems, logic design, computer graphics, man-machine interaction, and VLSI design methodology. The scope of this program includes experimental implementation where that is an integral part of the research.

• **Coordinated Experimental Research**—Support to establish and enhance experimental research facilities, aid technical and professional support personnel, and allow necessary maintenance of the facilities. Support is also possible for large multiinvestigator projects in experimental computer research of a scale not possible under regular programs. Grants are expected to have five-year durations. *Note: Deadline for proposals is September 16. Any received after that date will be returned.*

• **Special Projects**—General

and specialized projects focusing, for example, on societal issues in computer science, including office automation, personal computing, home delivery systems, computer crime and legal aspects of computing, and social and economic impact; new directions in computer science and applications, including computer networks and resource sharing, database privacy and security, and computer science education; computer-based modeling; human/computer interface; and other topics of special interest in computer research.

• **Computer Research Equipment**—Support for the purchase of special-purpose equipment for computer research. Funds for maintenance during the first year of operation may also be requested. The equipment should be necessary for the pursuit of specific research projects. It must be needed by more than one project and must be the kind of equipment that would be difficult to justify for one project alone. The total cost must be at least $10,000. Significant cost-sharing is required (minimum one-fourth of the costs met). *Note: Deadline for proposals is December 1. Proposals received after that date will be returned.*

Physics

• **Elementary Particle Physics**—States of matter and their properties and interactions; data that can be compared with theoretical models and ideas about the nature of the submicroscopic world. Support goes primarily to university groups to conduct experimental research at the major accelerator centers at national laboratories or at specialized university-based or university-affiliated laboratories.

• **Intermediate Energy Nuclear Physics**—Dynamics of nuclear and nucleon excitations and nuclear reactions, studied with primary and secondary beams from accelerators with energies greater than about 100 MeV; roles of excited meson states in nuclei; basic interactions and fundamental symmetries investigated at the interface between particle and nuclear physics. The program supports national facilities and user groups.

• **Nuclear Physics**—Structure and dynamics of nuclear matter and reactions among nuclei studied with light and heavy ions from a variety of accelerators and with neutrons. Emphasis is on the study of universal symmetries and conservation laws relevant to strong, electromagnetic, and weak interactions as well as the bulk properties of nuclear matter. Interdisciplinary efforts and applications to other fields are also important components.

• **Atomic, Molecular, and Plasma Physics**—Properties and interactions of particles at the atomic, molecular, and more complex aggregation levels in which the

Chemistry

atomic characteristics dominate. Specific interests include measurement of precisely defined states of atoms and the interaction of these states with other such atoms; formation and properties of highly perturbed electronic configurations in light and heavy atoms; study of the complex states formed during close collisions of heavy atoms; ultraprecise measurements of atomic properties to verify basic theories and find expressions of new physical laws; general and collision-free plasmas.

• **Theoretical Physics**—Quantitative hypotheses to interpret results of experimental physics and to suggest new directions for research on the properties of physical systems, from quarks and nuclei to stars. Emphasis is on particle, nuclear, and atomic theories.

• **Gravitational Physics**—Theory of strong gravitational fields and applications to astrophysics and cosmology; fine details of weak gravitational fields; gravitational radiation; gravitational interaction with quantum mechanical systems.

• **Structural Chemistry and Thermodynamics**—Equilibrium and time-dependent thermodynamics and statistical mechanics; macroscopic properties of matter; intermolecular interactions in condensed phases; properties of colloidal systems; high-temperature chemistry; new methods for structure determination; measurement and interpretation of the geometrical parameters of chemical species by spectroscopic and diffraction methods; related instrument development.

• **Chemical Physics**—Development of a general chemical theory to aid in the design and interpretation of experimental studies; chemical studies of single collisions of atoms and molecules; acquisition and interpretation of data on the interaction of radiation with atoms and molecules; study of energy transfer within and between individual molecules; gas phase kinetic studies to develop general laws and theories in chemistry.

• **Chemical Dynamics**—Kinetics and mechanisms of chemical reactions in condensed media; correlations and generalizations relating molecular structure, energetics, and reactivity; characterization of transient intermediates and their roles in producing chemical change; influence of chemical environments, catalysts, and energy sources on rates and products of chemical reactions; innovative techniques and instruments to study reactivity; fundamental rate data for use in allied disciplines.

• **Chemical Analysis**—New and improved methods for the analysis of all forms of matter in

all media; analytical procedures that couple novel chemistry with advanced instrumentation; comprehensive approaches to the characterization of surfaces and complex materials.

• **Synthetic Inorganic and Organometallic Chemistry**—New organometallic and inorganic compounds; fixation of small molecules; fuels and biomimetic models; inorganic compounds in chemotherapy and plant and animal nutrition; environmental impacts of heavy ions; synthesis of inorganic substances and materials that have useful catalytic, electrical, and thermal properties.

• **Synthetic Organic and Natural Products Chemistry**—Design and synthesis of theoretically important molecules to test theories of structure, bonding, and significant properties; development of highly efficient reagents and methds for synthesis of important organic molecules; synthesis of molecules mimicking properties of living systems; isolation, characterization, modification, and synthesis of natural products and study of their origins.

• **Chemical Instrumentation**—Aid to universities and colleges in acquiring major items of multiuser instrumentation essential for better fundamental research in chemistry.

Materials Research

• **Solid-State Physics**—Experimental research on metals, semiconductors, and insulators in the crystalline state, the amorphous state, and intermediate states of disorder, involving studies of phase transitions and electronic, magnetic, and lattice structures and their excitations. Important areas include studies of physical phenomena at surfaces, at interfaces, and in microsystems; photon, electron, positron, ion, and neutron scattering from solids; transport properties; resonance studies; and nonlinear phenomena.

• **Solid-State Chemistry**—Experimental research on design, synthesis, and high-yield preparation of new materials for emerging science and technology; chemical reactivity of, within, and upon solids; new methods of solid-state synthesis; and physical properties of solids. Relates chemical composition and structure to chemical reactivity and to such physical properties as chemisorption, defects, electrical conductivity, mass transport, magnetism, reaction kinetics and mechanism, and chemical stability.

• **Low-Temperature Physics**—Experimental research on condensed matter that requires low and/or ultra-low temperatures, and the study of phase transitions and critical phenomena; the occurrence and nature of superconductivity among ordered or disordered alloys and compounds; nonequilibrium superconducting properties of weak

link and Josephson junction devices; superfluid properties of the isotopes of helium; and these and related phenomena as they pertain to systems of reduced dimensionality and reduced crystalline perfection.

• **Condensed Matter Theory**—Theoretical research on condensed matter, involving studies of phase transitions and critical phenomena, kinetics of condensed matter systems far from equilibrium, elementary excitations, linear and nonlinear lattice dynamics, defects, surfaces, electronic and magnetic states, transport and optical properties, and macroscopic quantum properties such as superconductivity and superfluidity.

• **Metallurgy**—Theoretical and experimental investigations to determine fundamental structure; property relations and predictive behavior of crystalline and amorphous metallic systems in various environments; corrosion, erosion, abrasion, and wear phenomena; modification of surface and near-surface structure by ion implantation and relationship to properties; nucleation and growth; kinetics of liquid-solid and solid-solid phase transformations; solidification phenomena; computer studies of phase equilibria, grain boundary, and interfacial phenomena; clustering, ordering, and segregation effects; fundamental aspects of creep, fatigue, and fracture processes; nonlinear anelastic behavior of metallic systems; deformation mechanisms.

• **Ceramics and Electronic Materials**—Research on fundamental properties of ceramic materials (e.g., glasses, refractory oxides, carbides, borides, and nitrides) and electronic materials (semiconductors, intercalated graphites, etc.). Research is supported on (1) materials preparation, processing, and structural characterization; (2) the effects of defect structure and microstructure on electrical, magnetic, and optical properties; and (3) mechanical properties, failure mechanisms, and environmental properties (including corrosion) of ceramic materials.

• **Polymers**—Research on the fundamental behavior of synthetic macromolecules and the complexities resulting from their large size; synthesis of new polymers of high molecular weight and precisely defined structure; characterization of the chemical and physical structure of polymers; molecular arrangements in amorphous and crystalline polymers, and in their mixtures; macromolecular chain dynamics and relaxations; molecular characteristics and their relation to mechanical, optical, transport, surface, and solution properties; theoretical treatment of macromolecular behavior.

• **Materials Research Laboratories**—Major interdisciplinary laboratories designed to complement individual research funding by undertaking programs of a scope or complexity not normally feasible under traditional support. Essential activities include the development and operation of central experimental facilities, for the joint use of faculty and students, major cooperative research programs in important materials problems or problem areas, and seeding of novel concepts and ideas in materials research.

• **Instrumentation for Materials Research**—Support for multiuser, multidisciplinary instrumentation; instrument and technique development; major equipment that normally would be handled by a single program but costs more than $200,000; closed-cycle helium liquefaction systems.

• **Materials Research Groups**—Support for collaborative, multi-investigator research within the purview of the Division of Materials Research. Such research is expected to address major problems in materials research which require the combined expertise of several investigators and requisite instrumentation. Support for such research is expected to be three to five times larger than that provided in individual grants.

• **National Facilities**—Research facilities and specialized instrumentation available on a national scale to the research community in general and the materials research community in particular. These facilities provide unique research capabilities that can be located only at one or a very few laboratories in the Nation. Examples include facilities and resources for research using high magnetic fields, ultraviolet and X-ray synchrotron radiation, small-angle neutron scattering, and ultra-high resolution electron microscopy.

For more information on the National Facilities, contact them as follows:

Cornell High-Energy Synchrotron Source
Wilson Laboratory
Cornell University
Ithaca, New York 14853
(607) 256-7163

Wisconsin Synchrotron Radiation Center
University of Wisconsin-Madison
3725 Schneider Drive
Stoughton, Wisconsin 53589
(608) 873-6651

National Center for Small-Angle Scattering Research
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830
(615) 574-5232

Francis Bitter National Magnet Laboratory
Massachusetts Institute of Technology
170 Albany Street
Cambridge, Massachusetts 02139
(617) 253-5517

Regional Facility for High-Resolution Electron Microscopy
Center for Solid-State Sciences PSB-255
Arizona State University
Tempe, Arizona 85287
(602) 965-6459

Regional Facility for Surface Analysis
423 Shepherd Laboratories
University of Minnesota
100 Union Street, S.E.
Minneapolis, Minnesota 55445
(612) 376-9333

Regional Facility for Surface Science and Submicron Analysis
Department of Physics
Montana State University
Bozeman, Montana 59717
(406) 994-3614

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ENGINEERING

These NSF programs seek to strengthen engineering research and, as appropriate, to focus some of that research on areas relevant to national goals. This is done by supporting projects across the entire range of engineering disciplines and by identifying and supporting special areas where results are expected to have timely and topical applications. NSF's engineering programs seek to improve the possibilities for converting research concepts and results into practical use.

The specific objectives of the engineering activity are to:

- Advance fundamental knowledge of engineering principles that will be applied to the analysis and design of a large variety of man-made devices, systems, and processes.
- Strengthen the academic engineering research base and address the need for more basic research to underlie industrial technology innovations.
- Create an improved research environment that will encourage larger numbers of engineers to seek graduate education and academic careers, as well as pursue research.
- Stimulate the application of engineering knowledge to the solution of significant problems of national interest.

The Engineering Directorate consists of five major areas:

- Division of Electrical, Computer, and Systems Engineering
- Division of Chemical and Process Engineering
- Division of Civil and Environmental Engineering
- Division of Mechanical Engineering and Applied Mechanics
- Office of Interdisciplinary Research.

Eligibility

The most frequent recipients of support for research are academic institutions and nonprofit research institutions, although awards are occasionally made to profitmaking organizations, individuals, and State, local, and Federal Government agencies.

Most awards result from unsolicited research proposals, which should be prepared according to the guidelines set forth in *Grants for Scientific and Engineering Research* (NSF 83-57).

Deadlines

Submit proposals at any time. Proposals received too late for consideration in a particular fiscal year (ending September 30) are considered in the following year. If a specific start date for the proj-

Electrical, Computer, and Systems Engineering

ect is important, clearly explain the circumstances and allow at least six-months lead time for review and processing.

For More Information

Contact the Special Assistant, Directorate for Engineering, National Science Foundation, Room 537, Washington, D.C. 20550. (202) 357-9571. Or write directly to the appropriate Engineering division or office.

Areas of Research

The Division of Electrical, Computer, and Systems Engineering supports research on basic electrical phenomena and in the synthesis and analysis of devices, circuits, and systems. New knowledge resulting from this research contributes to technological innovations. Programs support theoretical, experimental, and design investigations in automation and robotics; signal processing and communications; lasers, beams, and plasmas; solid-state devices and microstructures engineering; systems engineering, including large-scale systems and computer-aided manufacturing and operations research; hardware, software, and algorithms for numerical and symbolic processing; bioengineering and science and technology to aid the handicapped.

Specific areas of research include:

- **Automation, Instrumentation, and Sensing Systems**—Research concerned with developing a better understanding of the machine decision and control process. Subsystems involved with machine intelligence include smart sensors, pattern analysis and processing, automated data acquisition and scene analysis, as well as robotics and end-effector control. Research leading to novel and unique instrumentation systems is also supported.
- **Computer Engineering**—Novel computer architectures implemented in very-large-scale integration, special-purpose computing structures, hardware/software design methods, software technology, and distributed and parallel processing. Robotics research focuses on new computer architectures and special-purpose hardware for real-time computation, and design and implementation of new computer languages.
- **Electrical and Optical Communications**—Systems methodology and devices for optical communications, large-scale computer communications networks, digital signal processing, information theory, and electronic circuits, including computer-aided design and very large scale integrated (VLSI) implementation.
- **Quantum Electronics, Waves, and Beams**—Topics in quantum electronics, plasmas, electro-

magnetics and acoustics. This research is typically related to the generation, propagation, and detection of electromagnetic and acoustic waves and the production and manipulation of charged particles.

• **Solid-State and Microstructures Engineering**—Solid-state electronics with emphasis on novel devices and integrated electronics processing techniques. Devices include silicon and compound semiconductor, superconducting, optical, magnetic, and surface acoustic wave. Emphasis on submicron devices and microfabrication techniques.

• **Systems Theory and Operations Research**—New methods of analysis, modeling, estimation, identification, control, and optimization that can be applied to systems and processes; mathematical techniques in operations research (both linear and nonlinear); and integer programming, scheduling, queueing, location, and routing.

• **Bioengineering and Research for the Handicapped**—Bioengineering supports research on the fundamental concepts and design of sensors, transducers, and instrumentation; imaging systems; modeling, simulation, and analysis; and the interaction of ultrasonic and electromagnetic energy with living systems.

Research for the Handicapped supports studies that produce knowledge with high potential for aiding physically disabled persons, including synthetic speech and recognition; innovative communication and control systems; robotics technology for prosthetic engineering; orientation and mobility aids; and functional electrical stimulation.

Chemical and Process Engineering

The Division of Chemical and Process Engineering focuses on the design, optimization, and operation of a wide range of processes in the chemical, petroleum/petrochemical, food, biochemical/pharmaceutical, mineral, and allied industries. The division supports research that lays the foundation for technological innovation in chemical and process industries. These efforts include the study and development of fundamental principles, design and control strategies, mathematical models, and experimental techniques that cut across a large number of industries and processes.

Areas of support include catalysis; combustion; plasma chemistry; biochemical, electrochemical, macromolecular, and separation processes; particulate characterization and interaction; thermodynamic and transport properties; and renewable and nonrenewable materials processing. Specific areas of research include:

• **Kinetics, Catalysis, and Reaction Engineering**—The rates

and mechanisms of important classes of catalyzed and uncatalyzed chemical reactions as they relate to the development or control of chemical processes or to the design and operation of chemical reactors, including electromagnetic and photochemical processes.

• **Chemical and Biochemical Processes**—Basic engineering aspects of biochemical engineering, process control, process design, polymer processing, and food process engineering.

• **Engineering Energetics**—Basic understanding of energetic processes, including plasmas (plasma coating, etching, and synthesis of materials; arc technologies); combustion of conventional and composite fuels; nuclear engineering (neutron transport, reactor dynamics, etc.); energy conversion, including magneto-hydrodynamics, thermionics, and direct energy conversion.

• **Thermodynamics and Transport Phenomena**—Thermodynamic properties and theories, transport and diffusional processes, interfacial and surface phenomena, mass transfer and turbulent mixing in pure fluids, mixtures, and dispersed phases. Systems studied provide data, correlations, and theory useful in the design of chemical, polymer, and energy-related processes.

• **Particulate and Multiphase Processes**—Characterization of particles and particulate systems, interfacial and colloidal phenomena, and processing and modification of dispersed solid, liquid, and gas particulate systems.

• **Separation Processes**—Improving performance and understanding of existing processes and devising novel ones for the efficient separation of chemical species in process streams.

• **Minerals and Primary Materials Processing**—Producing and handling minerals, metals, refractories, ceramics, and other inorganic raw materials.

• **Renewable Materials Engineering**—Engineering problems relevant to conversion and use of biologically based raw materials.

Civil and Environmental Engineering

The Division of Civil and Environmental Engineering deals with (1) extending our understanding of the basic behavior of natural and man-made physical structures and systems from both the elemental and macroscopic viewpoints, and (2) studying the effects of human activities on the natural environment. Hence, one objective of these programs is to increase understanding of how to design, construct, maintain, reconstruct, and operate an efficient, satisfactory, and economical built environment or infrastructure. A second objective is to study the phenomena involved in earthquake hazards and, through research, point out

ways to mitigate these hazards. Specific areas of research include:

• **Geotechnical Engineering**—Soil, rock, snow, and ice mechanics; engineering geology and geophysics; and methods of analysis and design related to construction, mining, drilling, and natural hazard engineering.

• **Structural Mechanics**—Advances in construction materials; structural loadings, including natural effects such as wind; analytical methods, use of computers, laboratory and full-scale experimental studies; reliability and optimization methods; evaluation of existing structural systems and materials.

• **Hydraulics, Hydrology, and Water Resources Engineering**—Efforts to (1) gain a better understanding of natural phenomena of engineering interest and (2) build a scientific foundation for engineering practices and procedures in such areas as groundwater flow, erosion and sediment transport, rainfall-runoff relationships, optimization of water resources systems, and coastal and ocean engineering.

• **Environmental and Water Quality Engineering**—Fundamental engineering principles relating to quality aspects of water supply, storm and sanitary drainage, water and wastewater treatment, and the diffusion, dispersion, and interactions of environmental pollutants.

• **Construction Engineering and Building Research**—Research to develop knowledge basic to (1) the construction of engineered facilities and (2) the design, construction, and efficient operation of buildings. A limited amount of research dealing with fundamental topics in transportation engineering is supported.

• **Earthquake Hazard Mitigation**—An integral component of the President's National Earthquake Hazard Reduction Plan, this program provides the primary source of Federal support for engineering research on ways to mitigate earthquake hazards. The program's principal focus is on the behavior of geotechnical materials and the structural response of engineering facilities to earthquake loadings. However, it also deals with research related to society's response to earthquakes and other natural disasters.

Mechanical Engineering and Applied Mechanics

The Division of Mechanical Engineering and Applied Mechanics supports research driven by both intrinsic interest in the phenomena that arise in technological applications and the need to solve problems in mechanical engineering and mechanics. Division objectives include support of basic research in the general areas of fluid mechanics, solid mechanics, and heat transfer,

and aid to solve fundamental problems in designing mechanical systems and devising the best industrial production processes.

• **Solid Mechanics**—Deformation and failure of solid materials (constitutive equations and fracture mechanics), structural integrity (including nondestructive evaluation and acoustic emission), material processing, structural materials, porous and granular materials, composite materials.

• **Fluid Mechanics**—Hydrodynamics, stability and turbulence, rheology, fluid biomechanics, multiphase flow and nonlinear waves.

• **Heat Transfer**—Heat transfer in porous materials, physical mechanisms of boiling and condensation of fluids; heat transfer in two-phase flow; novel techniques for heat transfer measurement; fundamentals of dry and wet cooling towers; schemes for the use of waste heat; heat transfer enhancement for heat exchangers.

• **Mechanical Systems**—Dynamical systems and control (including robotics), design methodology and interactive graphics, machine dynamics (including noise and vibration), tribology (including modeling, materials and diagnostics).

• **Production Research**—Unit operations and computer-integrated manufacturing processes; potential for fabricating materials; methods engineering; engineering economy; productivity of white collar workers and managers. Themes include manufacturing systems, factory automation, and product quality.

Office of Interdisciplinary Research (OIR)

OIR has two main functions that support the Directorate for Engineering and the NSF as a whole:

• **Engineering Research Centers**—The Directorate for Engineering will launch this new program in fiscal year 1985. The Engineering Research Centers will provide research opportunities to develop fundamental knowledge in cross-disciplinary technological areas of major national and industrial importance. The Centers are to involve team efforts; emphasize the systems aspects of engineering; help educate students in synthesizing, integrating, and managing engineering systems; incorporate industrial involvement and support; and include a significant educational component involving both graduate and undergraduate students. U.S. academic research institutions with engineering research and education programs are invited to submit proposals; complete information is in the program announcement NSF 84-22.

The program will be managed by the Office of Interdisciplinary Research along with program di-

rectors representing the principal disciplines involved.

• **Interdisciplinary Research Stimulation and Coordination**—OIR also coordinates committees of NSF program directors to stimulate support of research touching major technological or societal issues. The current committees are Biotechnology; Robotics and Automated Manufacturing; Research for the Handicapped; and Soils and Soil Science. Program announcements are available for the first three areas at this writing. Partial funding is available through OIR for basic and applied research potentially relevant to the handicapped. Proposals should be submitted to the disciplinary programs with potential use for the handicapped emphasized, and an information copy sent to OIR.

OIR will help process complex interdisciplinary research proposals that span the interests of several NSF programs. Working with program directors, OIR will coordinate the peer review of proposals and gather joint support if warranted. Applicants submit research proposals through the normal process to an appropriate disciplinary program, with an information copy to OIR, which rarely devotes funds to the support of these proposals.

OIR supports workshops and symposia to define research needs in high-visibility, cross-disciplinary areas related to technological issues or involving the interaction of engineering and scientific skills. State-of-the-art review papers are also funded; they analyze such areas and identify research opportunities and needs. Proposals are accepted at any time.

For More Information

Researchers with specific interests should contact OIR staff, Room 1121, (202) 357-9707.

Engineering Research Equipment Grants

NSF provides funds for research equipment as part of regular research grants, and it also makes separate awards exclusively for such equipment at institutions of higher education. The objective of this type of grant is to improve the quality or broaden the scope of work to be done at the proposing institution.

Important considerations in making these awards are the quality and importance of the research for which the equipment is to be used; the appropriateness of the equipment and its expected contribution to the research; the qualifications and past record of the principal investigator and associated staff; provisions for essential supporting facilities and maintenance of the proposed equipment; and the impact of the equipment and research on the infrastructure of academic engineering.

Engineering Research Initiation Grants

This program provides an opportunity for recently appointed assistant or associate professors to initiate academic engineering research. Proposers compete for funding only with one another and not with more senior researchers. Goals are to encourage faculty to begin their research careers and to make an academic career in the engineering fields more attractive to recent graduates. The program is directed toward full-time engineering faculty members who have had no prior substantial research support. Grants, awarded on a competitive basis, are to be used for the initiation of theoretical and/or experimental research projects in any research area normally supported by the Directorate for Engineering. The deadline for receipt of proposals is December 3. A brochure, *Engineering Research Initiation Grants*, is available on request from the Staff Associate, Directorate for Engineering, Room 1115, NSF, Washington, D.C. 20550. (202) 357-9834.

Eligibility

Equipment proposals are accepted from U.S. academic institutions with engineering research programs in areas normally supported by the Engineering Directorate. Awards will be made according to guidelines in the NSF booklet *Grants for Scientific and Engineering Research* (NSF 83-57) and program announcement 84-51, *Engineering Research Equipment Grants.*

Deadlines

The target date for receipt of proposals is December 15. Proposals received after this date will be reviewed, although they may miss a scheduled panel meeting.

For More Information

A brochure, *Engineering Research Equipment Grants*, is available on request from the Staff Associate, Directorate for Engineering, Room 1115, NSF, Washington, D.C. 20550. (202) 357-9834.

3

BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES

Individual research projects supported by these programs are designed to strengthen scientific understanding of biological and social phenomena. Research is supported across the spectrum, from the fundamental molecules of living organisms to the complex interactions of human beings and societal organizations.

Although most of the projects supported are on the "basic" end of the research spectrum, the programs accept and fund proposals for applied work as well. Support may also be provided for research workshops, symposia, publications and monographs, conferences, the purchase of scientific equipment for research purposes, the operation of specialized research facilities, and the improvement of research collections.

To provide reasonable assurance of long-term support for continuing projects of high scientific merit, funding may be provided for periods up to 60 months, in annual increments, contingent upon the availability of funds and satisfactory progress of the research.

Institutions are required to share in the cost of unsolicited research projects supported by NSF grants or contracts.

Before submitting a proposal for research support, consult the brochure *Grants for Scientific and Engineering Research* (NSF 83-57) for guidance in preparing the application. A recommended format and some standard forms are in the brochure.

For information on Doctoral Dissertation Research Improvement awards, see chapter 7, "Other Activities."

Eligibility

The most frequent recipients of support for basic scientific research in the biological, behavioral, social, and information sciences are academic institutions and nonprofit research groups. In special circumstances, grants also are awarded to other types of institutions and to individuals. In these cases, preliminary inquiry should be made to the appropriate program officer before a proposal is submitted. Support may be provided for projects involving a single scientist or a number of scientists. Awards are made for projects confined to a single disciplinary area and for those that cross or merge disciplinary interests.

Deadlines

Submit proposals at any time; allow about six to nine months for review. Proposals to be funded in a particular fiscal year (ending September 30) normally should be received no later than Janu-

ary of that year. Target dates, which vary by division, are published in the *NSF Bulletin*.

For More Information

Contact the responsible division director, National Science Foundation, Washington, D.C. 20550.

Areas of Research

The major research areas of NSF programs in the Biological, Behavioral, and Social Sciences are summarized below. Note: Support is not provided for clinical research (diagnosis or treatment of disease, abnormality, or malfunction in people or animals or testing of drugs or procedures for their treatment).

Cellular Biosciences

• **Cell Biology**—The biology of prokaryotic and eukaryotic cells *in vivo* and in culture; structure and function of the cytoskeleton, membranes, chromosomes, and cell organelles; meiosis and mitosis; growth control; biogenesis and processing of cell structural elements; regulation of cell shape, polarity, and motility; mechanisms of endocytosis, secretion, and other cell activities.

• **Cellular Physiology**—Reception of signals by cells, message transduction within cells, and the responses of cells to that information. Includes studies on the immune response, mechanisms of hormone action, and regulation of muscle contraction.

• **Developmental Biology**—Mechanisms involved in the development and growth of plants and animals. Areas included are embryogenesis, morphogenesis, reproduction, pattern formation, gene expression, cell-cell interactions, differentiation, and regeneration. Emphasis is on the experimental analysis of developing systems.

• **Eukaryotic Genetic Biology**—Organization, characterization, function, recombination, regulation of expression, repair of damaged DNA, and transmission of heritable information (both nuclear and extra-nuclear) in eukaryotes. Genetic interactions between eukaryotic hosts and parasites.

• **Regulatory Biology**—Characteristics and evolution of mechanisms, such as endocrine and neuroendocrine systems, that initiate, integrate, and regulate physiological functions in tissues, organs, and organisms. Physiological adaptation of animals to environmental variables, including conditions of stress.

• **Alternative Biological Resources**—Use of biological systems and biomass conversion as alternative sources of industrial chemicals and materials. Major areas supported: biological conversion of lignocellulose; underutilized resources, such as arid land plants, as sources of industrial chemicals; biological nitrogen fixation and plant stress (drought, salinization, etc.).

• **Biochemistry**—Structure and function of proteins, carbohydrates, and nucleic acids, and the identification of the molecular parameters that determine their functions; the mechanism and regulation of the biosynthesis of DNA, RNA, proteins, carbohydrates, and lipids; enzyme structure and function; the biogenesis, topography, and assembly of membranes and macromolecular complexes; virus structure, assembly, replication, and expression.

• **Biophysics**—Structure, dynamics, and interactions of biologically important macromolecular compounds; relationship of structure to function in these compounds; changes and alterations in physical and chemical properties of these compounds that occur during the functional state; supramolecular transfer and electron transfer in biological macromolecules, systems, and assemblies.

• **Prokaryotic Genetic Biology**—Organization, function, transmission, regulation, and recombination of genetic information in prokaryotic organisms, including viruses; repair of damaged DNA, gene evolution, genetics of microbial interactions with eukaryotic organisms, and genetics of microbial plasmids are included.

• **Metabolic Biology**—Mechanisms of regulation and characterization of biochemical pathways by which plant, microbial, and animal systems assimilate and transform metabolites, provide energy for vital processes, and respond to environmental changes. The program does not generally support research in biochemical pharmacology, metabolism of xenobiotics, or the metabolic basis of disease.

Biological Instrumentation

The purchase of major, specialized instruments for use by groups of investigators in both cellular and molecular biological research; development of biological instruments that are not now available commercially and will increase the accuracy and sensitivity of research observations.

Postdoctoral Research Fellowships in Plant Biology

Supported by both Cellular Biosciences and Molecular Biosciences, this initiative is designed to encourage a wide range of biological and physical scientists to pursue research careers in the plant sciences, and to let recipients choose research environments that will be most beneficial to their future scientific development. Applicants should present a research plan that contributes to a basic understanding of plant biology at the molecular, cellular, or whole plant level, preferably in a discipline or subfield other than that of their doctoral train-

Molecular Biosciences

Biotic Systems and Resources

ing— for example, a microbial geneticist studying the regulation of enzymes in plants or a physical chemist studying ion transport in plants. For more information, contact the program by writing NSF or calling (202) 357-9782.

• **Ecology**—Community ecology of land and inland waters, with emphasis on interactions such as competition, herbivory, pollination, and predation in natural and agricultural ecosystems, and coevolution within interacting groups; microbial ecology of soils and sediments, especially in relation to decomposition, nutrient cycling, and productivity; influences on the distribution and abundance of animal and plant communities both now and in the recent geological past.

• **Ecosystem Studies**—Field, laboratory, and mathematical modeling studies of the processes and components of natural, managed, and man-dominated terrestrial, freshwater, and wetland ecosystems; new methods of predicting ecosystem change and mathematically analyzing functional interdependencies in complex, highly variable systems; information on ecosystem management and exploitation.

• **Systematic Biology**—The identities, relationships, and distributions of living species of plants, animals, and microorganisms; fossil studies of extinct species to determine changes in biotic diversity through the earth's history; improved methods of gathering, processing, and analyzing systematic data; functional morphology; chemosystematics.

• **Biological Research Resources**—Operational and refurbishment support for biological research resources—including living-organism stock centers, biological field-research facilities, and systematic research collections—to enhance the use of these resources by U.S. scientists.

• **Population Biology and Physiological Ecology**—General principles that describe the adaptations of animals and plants to their microenvironments; evolutionary and ecological significance of life-history characteristics of plants and animals (including behavioral ecology); theoretical models for ecological genetics; adaptive significance of genetic variability; physiological aspects of genetically determined enzyme variability.

Behavioral and Neural Sciences

• **Developmental Neuroscience**—Factors that influence the formation, growth, aging of the nervous system; how neurons and glia differentiate and regenerate; how connections between neu-

rons are formed and maintained; and the interactions of environmental and genetic factors in neural development.

• **Integrative Neural Systems**—Pathways and mechanisms that process neural activity, generate simple and complex patterned motor outputs, produce plastic responses (such as those underlying learning) and carry signals to the muscle cells; and the mechanisms of nerve-to-muscle transmission, reflexive behaviors, and the activities of the autonomic nervous system.

• **Molecular and Cellular Neurobiology**—Biochemical and biophysical properties of neurons and glia which determine their special functions; molecular events related to the regulation of transmitter and receptor synthesis; generation and transmission of electrical impulses by the neuron; metabolic events that respond to changes in neuronal activity; and approaches using genesplicing and monoclonal antibodies in the study of neural mechanisms.

• **Sensory Physiology and Perception**—Sensory mechanisms and processes at the molecular, cellular, physiological, and behavioral levels involved in transduction, neural coding, and information processing; neurobiological and psychophysical correlates of sensory and perceptual phenomena.

• **Psychobiology**—Field and laboratory studies of behavior and its genetic, environmental; hormonal, neural, and motivational determinants, using a wide range of observational, experimental; theoretical, comparative, and quantitative approaches; animal learning and memory, conditioning and stimulus control, preferences and aversions, foraging and ingestion; migration and homing, communication, and the social and reproductive behaviors of animals.

• **Memory and Cognitive Processes**—Complex human cognitive behavior including memory, attention, concept formation; decisionmaking, reading, thinking, and problem solving; the development of cognitive processes in infants and children.

• **Social and Developmental Psychology**—Laboratory and field research in (1) all areas of human social behavior, including social perception, attitude formation and change, and social learning; (2) all areas of human social development in children and adults, including personality and emotional developmental processes.

• **Linguistics**—Syntactic, semantic, phonological, and phonetic properties of individual languages and of language in general; psychological processes in the production and perception of speech; biological foundations of language; social influences on and effects of language and dialect variation; formal and mathematical properties of language models.

• **Anthropology**—Archeology and cultural, social, and physical anthropology spanning all topics, geographic areas, and methodologies. Includes study of human origins and the interaction of population, culture, and environment; systematic research collections; improved methods of radiocarbon and other techniques of dating and analysis.

Social and Economic Science

• **Economics**—Microanalysis of economic aggregates, including national income, price levels, and employment; forces determining the time path of the economy in response to various stimuli; determinants and consequences of market structure; interaction of fiscal and monetary variables in open economies, particularly as these pertain to problems of inflation and unemployment; economic study of renewable and nonrenewable resources; nonmarket decisionmaking; labor economics and human relations; economic history and development; international economics; techniques of quantitative analysis; empirical validation and assessment of different types of economic models; mathematical economics.

• **Geography**—Explanation and impact of population shifts, migration decisions, industrial location, regional stagnation, and residential choice; effects of public policy, environmental preference, and perceived travel costs on land-use decisions; geographic diffusion of innovations.

• **Sociology**—Processes by which organizations adapt to and produce change in their social context; decisionmaking in organizations and small groups; social context of human development and behavior; social factors in population change; social stratification and the development of careers and work roles; the role of communication and influence networks in individual and community decisions; effects of social organization on science and knowledge; variation in the social attributes of cities and their effects on competition for resources and population.

• **Measurement Methods and Data Improvement**—Survey operations research; methods and models for the quantitative analysis of social data; improvements in the scientific adequacy and accessibility of social statistical data, including those generated by government as well as the academic research community; applications of cogitive science and information science to social measurement.

• **History and Philosophy of Science**—The nature and processes of development in science and technology; the interaction between science and technology and their impact on society; the interactions of social and intellectual forces that promote or retard the advance of science; differences in the nature of theory and evidence in different scientific fields.

Note: The history of medicine is not supported.

• **Political Science**—Local, national, and international governmental institutions; the effects of structural factors on political participation and effectiveness; national election studies; the impact of economic and social change on political processes; factors influencing bureaucratic decisionmaking and policy formulation; processes of conflict and political instability.

• **Law and Social Sciences**—Processes that enhance or di-

minish compliance with and the impact of law; causes and consequences of variations and changes in legal processes and institutions; personal, social, economic and cultural factors affecting the use of and responses to law; the dynamics of disputing and dispute resolution mechanisms, processes, and strategies; the determinants of decisionmaking and rulemaking in legal forums and contexts; conditions and processes that influence the development of law and create transformations between formal legal rules and law in action.

• **Regulation and Policy Analysis**—Technical, economic, and social aspects of regulation, including the costs, benefits, and equity consequences of the U.S. regulatory regime; political and managerial decisionmaking in the regulatory process; business behavioral adaptations to regulations; the consequences of regulation for income and wealth distribution; economic efficiency aspects of regulation; the roles of the legislative and executive branches in promulgating regulatory regimes; the impact of regulation on innovation; the implications of regulation for work or job mobility.

• **Decision and Management Science**—Fundametal research on decisionmaking, management, and operational processes to build a body of knowledge that can be drawn upon to improve practice. Research is characterized by modeling, empirical observation, generalizability, and concern with social and behavioral factors. Proposals are accepted from investigators in all fields of science.

Information Science and Technology

• **Information Science**—Theoretical and empirical studies of the properties of information and the dynamics of information aggregation and transfer. Emphasis is on investigations of information-processing principles in pattern recognition, learning, memory, problem solving and issues relating to knowledge-based systems such as the use of natural languages, knowledge representation, complexity, uncertainty, and inference. Support also goes to research on structural properties of information collections and on methods of document and knowledge retrieval.

• **Information Technology**—Theoretical and empirical research advancing the design of information processing systems that augment human information-processing activity. Emphasis is on the generation, integration, transfer, retrieval, and display of diverse (text, numerical, pictorial, aural) modes of information; interactions between human and

machine information systems; and principles and methods of modeling the performance of information systems.

• **Information Impact**—Theoretical and empirical investigations of information and information technology as a factor in economic, organizational, and societal processes; research on the role of information and information technologies in the operation of economic mechanisms characterizing markets and firms, information and information technology in the economy as related to performance and productivity, social and behavioral consequences of information technologies involving interactive and knowledge-based systems, and the structure of information industries.

• **Research Initiation for New Investigators in Information Science**—Support to strengthen scientific manpower in the information sciences through opportunities for recent doctoral-level graduates. The program is directed toward full-time scientific faculty who have held the degree for four years or less and have not previously received awards for research in the information sciences. Grants, awarded on a competitive basis, are given to start projects in areas supported by the Division of Information Science and Technology. The deadlines for receipt of proposals are the first Wednesday in February for awards beginning June 15, and the first Wednesday in August for awards beginning December 15.

For More Information

Program announcements giving more information are available from the Division of Information Science and Technology, National Science Foundation, Washington, D.C. 20550.

4

ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES

Research in the Astronomical, Atmospheric, Earth, and Ocean Sciences is supported to increase scientific knowledge of the natural environment on earth and in space and of the various effects of human activity that interacts with this environment. General objectives of this research are to:

- Increase understanding of physical principles governing the universe and of the properties and behavior of astronomical objects, including the solar system, individual stars and stellar groups, and exotic phenomena such as quasars, active galactic nuclei, and molecular masers.
- Advance knowledge of the earth's upper and lower atmosphere, including its general circulation and the physical bases of climate, and the smaller-scale, shorter-term phenomena that describe weather processes.
- Provide further insights into the physical and chemical characteristics and processes that produce such geologic features as hydrocarbon and ore deposits and events such as earthquakes, volcanic eruptions, and landslides.
- Improve knowledge of the physical, chemical, geological, and biological processes in the world's oceans, and at their boundaries with the atmosphere, the shoreline, the sea floor, and the earth's crust beneath.
- Foster, in the antarctic and arctic regions, multidisciplinary research that (1) helps to solve regional and worldwide problems and to protect the environment, and (2) ensures equitable and prudent use of resources.

For information on Doctoral Dissertation Research Improvement awards, see chapter 7, "Other Activities."

Astronomical Sciences

The overall objective of the Astronomical Sciences program is to increase our knowledge of the universe. Research is aimed at determining the composition, structure, and evolution of planets, stars, and galaxies, including our sun and the Milky Way.

The National Science Foundation supports the development and operation of three National Astronomy Centers where radio, optical, infrared, and special telescopes are made available on a

competitive basis to the scientific community. Resident staffs at the Centers give technical assistance to visiting scientists, do studies of their own, and develop advanced instrumentation. These Centers meet national needs for research in specific areas of science requiring facilities, equipment, staffing, and operational support that could not appropriately be offered a single institution to the exclusion of others.

Unlike many federally sponsored research laboratories, the National Astronomy Centers do not perform specific research tasks assigned by or for the direct benefit of the Government. Instead, their purpose is to make available to all qualified scientists the facilities, equipment, skilled personnel support, and other resources the scientists need to do independent research of their own choosing.

ASTRONOMY PROJECT SUPPORT

The Astronomy Project Support program provides a broad base of support for fundamental research aimed at an understanding of the states of matter and physical processes in the solar system, our Milky Way galaxy, and the larger universe.

Deadlines

Submit proposals at any time during the year; allow about seven to nine months for review and processing.

For More Information

Contact the Division of Astronomical Sciences, Astronomy Research Section, National Science Foundation, Washington, D.C. 20550.

Areas of Research

- **Solar System Astronomy**—Theoretical and observational studies of the detailed structure and composition of planetary surfaces, interiors, atmospheres, and satellites; the nature of small bodies (the asteroids, comets, and meteors); and the relevance of all this to the origin and development of the solar system.

- **Stars and Stellar Evolution**—Theoretical and observational studies of the structure and activity of the sun; the physical properties of all types of stars; all aspects of stellar formation and evolution; the effects of mass loss, rotation, and magnetic fields; and the properties of stellar atoms and molecules of relevance to stellar astronomy.

- **Galactic Astronomy**—Theoretical and observational studies of the distribution and kinematics of stars in the immediate vicinity of the sun (through determining their distances and motions with the highest attainable precision); the characteristics of binary and multiple star systems, star clusters, and the interstellar medium; and the structure and evolution of the Milky Way galaxy.

- **Extragalactic Astronomy**—Theoretical and observational studies of extragalactic objects ranging from the nearest galaxies to the most distant quasars and their relevance to galactic evolution and cosmology.

- **Astronomical Instrumentation and Development**—Development and construction of state-of-the-art detectors and data-handling equipment; procurement of detection and analysis systems for telescopes at institutions that presently lack such systems; development of interactive picture-processing systems; very-long-baseline interferometric instrumentation; and application of new technology and innovative techniques to astronomy.

- **Electromagnetic Spectrum Management**—Coordination with Government agencies of electromagnetic spectrum usage for research, as well as frequency assignments for other telecommunications/electronics systems.

NATIONAL ASTRONOMY AND IONOSPHERE CENTER

NSF supports the National Astronomy and Ionosphere Center (NAIC), a visitor-oriented National Research Center devoted to scientific investigations in radio and radar astronomy and atmospheric sciences. NAIC is operated and managed under contract to NSF by Cornell University. NAIC headquarters are in Ithaca, New York, and its principal observing facilities are located 19 kilometers south of the city of Arecibo, Puerto Rico.

NAIC provides telescope users with a wide range of research and observing instrumentation, including receivers, transmitters,

movable line feeds, and digital data acquisition and processing equipment. The Center has a permanent staff of scientists, engineers, and technicians who are available to help visiting investigators with their observing programs.

The principal research instrument is a 305-meter, fixed spherical radio/radar telescope—the world's largest single radio reflector. The frequency capabilities range from 50 megahertz to 5 gigahertz. Transmitters include an S-band (2,380-megahertz) radar for planetary studies and a 430-megahertz radar system for aeronomy studies. A second observing site, located 9.6 kilometers from the main site, has a 30.5-meter steerable parabolic antenna; it is paired with the main antenna to provide an effective interferometric S-band radar mapping system. This antenna pair is also available for radio astronomy interferometry at a wavelength of 12 centimeters.

The S-Band Planetary Radar System is now available for high spatial resolution studies of stratospheric dynamics. A high-power ionospheric heating facility (HF) provides a unique capability to investigate nonlinear plasma phenomena in the ionosphere. The data-processing capabilities of the Observatory include a Harris computer system and an array processor.

Eligibility

The NAIC facilities and instrumentation are available on a competitive basis to qualified scientists from all over the world. Telescope time is assigned after judgment of research proposals on the basis of scientific merit, the capability of the instruments to do the work, and the available telescope time.

For More Information

Contact the Director, National Astronomy and Ionosphere Center, Cornell University, Ithaca, New York 14853.

NATIONAL OPTICAL ASTRONOMY OBSERVATORIES

NSF supports the Optical Astronomy Observatories (NOAO) as the Nation's center for research in ground-based optical and infrared astronomy. Large optical telescopes, observing equipment, and research support services are made available to qualified scientists.

The headquarters of NOAO are in Tuscon, Arizona. NOAO includes Kitt Peak National Observatory (KPNO), Cerro Tololo Inter-American Observatory, and the National Solar Observatory. It is supported under the terms of a contract between NSF and the Association of Universities for Research in Astronomy, Inc. (AURA). A consortium of 17 major universities, AURA is responsible for operating and managing NOAO.

The observing facilities of KPNO are located on Kitt Peak, a 2,089-meter mountain 90 kilometers southwest of Tucson.

This is the site of the second largest reflector in the United States, the 4-meter Mayall Telescope. Among the other KPNO telescopes atop Kitt Peak are a 2.1-meter general-purpose reflector with optimized infrared observing equipment; a 92-centimeter coude feed (associated with the 2.1-meter); a 1.3-meter Cassegrain reflector for infrared observations and photometric studies; and two 91-centimeter auxiliary telescopes available for solar, planetary, and bright-object observations.

Solid-state array detectors, particularly of the charge-coupled device types, are being applied to several faint-object observational problems. Seven different infrared instruments are now in use on the 1.3-meter, 2.1-meter, and 4-meter telescopes, all of which are equipped with the chopping secondary mirror required for infrared work. Kitt Peak also operates the Harrison "C" ruling engine, currently the only source of large, high-efficiency diffraction gratings for the astronomical community.

Kitt Peak is also the site of three University of Arizona telescopes, a University of Michigan 1.3-meter telescope, a radio telescope operated by the National Radio Astronomy Observatory, and the Burrell Schmidt-type telescope of Case Western Reserve University.

Research carried out at NOAO encompasses fields ranging from solar physics to cosmology. The Observatory's basic programs involve the operation of nine telescopes. Many of the instruments, including the Mayall 4-meter telescope, are used for daytime in-

frared observations in addition to a wide variety of nighttime observations.

Cerro Tololo Inter-American Observatory (CTIO) provides qualified scientists with the telescopes and related facilities required for research in ground-based optical astronomy in the southern hemisphere.

CTIO has offices, laboratories, and housing for U.S.-hired staff, in the coastal city of La Serena, Chile, about 482 kilometers north of Santiago on the Pan American Highway. Observing facilities are located on Cerro Tololo, a 2,194-meter mountain on the western slopes of the Andes, about 64 kilometers inland from La Serena.

CTIO operates seven telescopes, including the 4-meter near-twin to the Kitt Peak 4-meter instrument. The others are the 1.5-meter, 91-centimeter, 61-centimeter (originally installed by the Lowell Observatory for planetary observations), and 41-centimeter reflectors; a 61/91-centimeter Schmidt telescope on loan from the University of Michigan; and a 1-meter reflector on loan from Yale University. These instruments are equipped with spectrographs, cameras, and photometers similar to the ones at Kitt Peak.

The National Solar Observatory (NSO) is devoted to optical research in the fields of solar physics, solar-terrestrial relationships, and related areas. NSO makes available to qualified scientists the world's largest collection of modern optical solar telescopes and auxiliary instrumentation designed to observe the solar photosphere, chromosphere, and corona.

NSO has observing facilities atop Kitt Peak, Arizona, and Sacramento Peak, New Mexico. The Kitt Peak facilities consist of the 1.5-meter McMath Solar Telescope, the world's largest solar research instrument, and a solar vacuum telescope/magnetograph, used for synoptic observations of the sun. Although the McMath telescope complex was designed primarily for solar observations, it is also used regularly for nighttime studies of planets and stars.

The Sacramento Peak observing facilities are located at an elevation of 2,800 meters on a crest of the Sacramento Mountains in south-central New Mexico, 59 kilometers east of Alamogordo.

The principal instruments are a 109-meter-high Solar Vacuum Tower telescope with an echelle spectrograph, digital diode array, and tunable filters, and an 8-meter spar in the Big Dome complex equipped with a 40-centimeter aperture coronagraph, a magnetograph, and a polarimeter.

Other instrumentation includes a full complement of spectrographs, birefringent filters, and photographic, video, and digital data acquisition and processing equipment.

An integral part of the NOAO program is to apply advanced technology to astronomical instrumentation. The Observatory's activities include development of two-dimensional optical and infrared detectors, large diffraction gratings, auxiliary instruments for existing telescopes, and engineering designs for telescopes of the future.

As a scientific visitor-oriented facility, NOAO receives many U.S. astronomers and a smaller number from abroad. The NOAO resident staff of astronomers, engineers, and various support personnel is available to assist these visitors in meeting their scientific goals.

Eligibility

The NOAO facilities and instrumentation are available on a competitive basis to all qualified U.S. scientists and, on occasion, foreign visitors. Telescope time is assigned after judgment of research proposals on the basis of scientific merit, the capability of the instruments to do the work, and the available telescope time. NOAO staff members and visiting astronomers are treated equally with regard to use of the facilities.

For More Information

Contact the Director, National Optical Astronomy Observatories, P.O. Box 26732, Tucson, Arizona 85726.

NATIONAL RADIO ASTRONOMY OBSERVATORY

NSF supports the National Radio Astronomy Observatory (NRAO), which makes radio astronomy facilities available to qualified scientists. The NRAO staff assists visiting scientists

with the large radio antennas, receivers, and other equipment needed to detect, measure, and identify radio waves from astronomical objects.

Headquarters for NRAO are in Charlottesville, Virginia. The three observing sites are located in Green Bank, West Virginia; Kitt Peak near Tucson, Arizona; and 80 kilometers west of Socorro, New Mexico. NRAO is supported under the terms of a contract between NSF and Associated Universities, Inc. (AUI), a consortium of nine universities that is responsible for NRAO operation and management.

Two telescope systems are operated at the National Radio Quiet Zone site in Green Bank. The premier telescope at Green Bank is the 43-meter instrument, which permits the study of spectral lines at centimeter wavelengths. The telescope is an integral part of the Very Long Baseline Interferometer network; this network is involved in studies of quasars and the high-resolution mapping of galactic objects over transcontinental and intercontinental distances. The large-aperture, 91-meter telescope is instrumented for survey studies of both continuum and spectral-line radiation from galaxies where its great sensitivity is an advantage.

A 12-meter millimeter-wavelength telescope is located on Kitt Peak to take advantage of the high altitude and dry climate necessary for short radio wavelengths. This telescope is capable of both continuum and spectral-line studies at wavelengths from 1 centimeter to as short as 1 millimeter.

The Very Large Array (VLA) west of Socorro, New Mexico, consists of 27 antennas, available for use in an interferometric mode for aperture synthesis observations of faint radio sources. Both continuum and spectral-line observations at wavelengths of 1.3, 2, 6, and 20 centimeters can be made.

The four-element interferometer at Green Bank is operated full time for the U.S. Naval Observatory on a program of measuring the earth's rotation and determining certain astronomical constants.

Eligibility

NRAO makes observing time on each instrument available for the use of all qualified U.S. scientists and, on occasion, foreign visitors. Telescope time is assigned after judgment of research proposals on the basis of scientific merit, the capability of the instruments to do the work, and the available telescope time.

For More Information

Contact the Director, National Radio Astronomy Observatory, Edgemont Road, Charlottesville, Virginia 22901.

Atmospheric Sciences

The Atmospheric Sciences program supports research to add new understanding of the behavior of the earth's atmosphere and its interactions with the sun. Included are:

- Studies of the physics, chemistry, and dynamics of the earth's upper and lower atmosphere.
- Research on climate processes and variations.
- Studies to understand the natural global cycles of gases and particulates in the earth's atmosphere.

NSF also provides support to operate the National Center for Atmospheric Research (NCAR) and the Upper Atmospheric Facilities (UAF). NCAR does research in atmospheric and related sciences and cooperates with universities and other organizations to coordinate large-scale atmospheric research projects. In addition, the Center operates major aircraft, computer, and other facilities for use by university and NCAR scientists.

The UAF consists of four large incoherent-scatter radar facilities located along a longitudinal chain from Greenland to Peru. They allow scientists to investigate both local and global upper atmospheric problems.

Finally, NSF provides support for participation by the U.S. scientific community in international scientific research endeavors, such as the Global Atmospheric Research Program (GARP).

ATMOSPHERIC SCIENCES PROJECT SUPPORT

The purpose of these programs is to continue to build a base of fundamental knowledge on the atmospheres of the earth, other planets, and the sun. Specific objectives are:

- To develop the scientific basis for understanding (a) the dynamic and physical behavior of climate and weather on all scales and (b) the natural global cycles of gases and particulates in the earth's atmosphere.
- To improve understanding of the composition, energetics, and particularly the dynamics of the coupled upper atmospheric system.
- To improve our knowledge of the sun as it relates to the earth's upper atmosphere and space environment.

Eligibility

Proposals may be submitted by academic institutions, nonacademic and nonprofit research organizations, profitmaking and private research organizations, and individuals. Occasionally, NSF sponsors efforts by other Government agencies, particularly for field programs.

Target Dates

Submit proposals at any time during the year for all programs except Climate Dynamics. Allow about six to nine months for review and processing. For the Climate Dynamics Program, target dates for proposal submission

are May 1, August 1, and December 1, to allow starting dates of November 1, February 1, and June 1, respectively.

For More Information

Contact the Division of Atmospheric Sciences, National Science Foundation, Washington, D.C. 20550.

Areas of Research

• **Aeronomy**—Upper and middle atmosphere phenomena of ionization, recombination, chemical reaction, photoemission, and transport; the transport of energy, momentum, and mass in the mesosphere-thermosphere-ionosphere system (includes the processes involved and the coupling of this global system to the stratosphere below and magnetosphere above); the plasma physics of phenomena manifested in the upper atmosphere-ionosphere system, including magnetospheric coupling efforts.

• **Atmospheric Chemistry**—The concentration and distribution of gases and aerosols in the atmosphere; chemical reactions among atmospheric species; interactions of atmospheric species with solar radiation; sources and sinks of important trace gases; precipitation chemistry; transport of gases and aerosols between the troposphere and stratosphere; polluted urban air chemistry; air transport and transportation of energy-related pollutants; and improved methods for measuring the concentrations of trace species and their flow through the atmosphere.

• **Climate Dynamics**—Causes of climate variability and the physical processes that govern climate; methods to predict climate variations and assess their impact on human activities; assembly and analysis of both paleoclimatic and modern climatic data; development and use of climate models to diagnose and simulate climate stages and variations.

• **Experimental Meteorology**—Field research on the physics and dynamics of the troposphere, including basic research related to intentional and inadvertent weather modification; precipitation development within cloud systems; the interaction between wind fields within cloud systems and the precipitation process; the development of mesoscale weather systems; and the role of mesoscale elements in large-scale cyclone and anticyclone formation.

• **Global Atmospheric Research Program (GARP)**—Supports research on the transient behavior of large-scale atmospheric phenomena that could lead to more accuracy in weather forecasts and research on the statistical properties of the atmosphere's general circulation that could lead to better understanding of the physical basis of climate. GARP is in its final research phase and activities will continue to diminish throughout the 1980's.

• **Meteorology**—How severe storms begin, organize, and last; the relationship of the electrical budget to the characteristics of cloud and precipitation particles; how tornadoes begin; the effects of haze layers and clouds on the radiation balance of the earth and atmosphere; the role of ice in the formation of natural clouds and precipitation and how ice crystals and nuclei can be measured; the major physical processes initiating and maintaining cyclonic storms in middle latitudes and how these developments relate to severe local storms. In addition, investigations of new observational techniques and instrumentation are also supported.

• **Solar-Terrestrial**—Upper atmosphere (including the magnetosphere) responses to the energy flux from the sun; mechanism by which the magnetosphere energizes particles from the sun and the ionosphere and deposits them into the polar upper atmosphere to form the aurora; nature of electric currents and particles that flow between the atmosphere, ionosphere, and magnetosphere; effect of variation in the sun's radiation on weather and climate.

CENTERS AND FACILITIES

NSF plans the support for, and oversees the science programs and use of, the following facilities:

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

NSF supports the National Center for Atmospheric Research (NCAR), located in Boulder, Colorado. NCAR is operated by the University Corporation for Atmos-

pheric Research (UCAR), a nonprofit consortium of 53 North American universities with graduate programs in atmospheric sciences, under a contract between the Foundation and UCAR. The NCAR staff numbers about 600 scientists and support personnel.

NCAR facilities serve the entire atmospheric sciences research community and part of the ocean sciences community. The facilities available to university, NCAR, and other scientists include a computing center equipped with large mainframes, instrumented research aircraft, and ground-based Doppler radars. NCAR develops new or improved instruments for measuring atmospheric and oceanic parameters; these include advanced weather radars, remote automatic weather observing stations reporting regularly to a central data collection point, upper air observing systems, and buoys for ocean observations.

NCAR scientists do research in the atmospheric and ocean sciences and in solar astronomy, and they collaborate in large research programs involving many institutions. Research programs are selected for their scientific merit, potential for progress, appropriateness for a national center, responsiveness to and fit with university activities, and relevance to society's needs.

NCAR research programs are in the following areas: the dynamic and physical processes that govern the behavior and climatology of the atmosphere and oceans; global and regional atmospheric chemical topics, including geochemical and biogeochemical cycles; the variable nature of the sun and the physics of the corona; the physics of clouds, convection, thunderstorms, and precipitation formation; and impact assessment analysis to investigate the important links between atmospheric and societal activities. In addition, NCAR provides fellowships for visiting scientists to conduct research and interact with NCAR scientists.

Eligibility

Facility and visiting scientist support is provided on a competitive basis to qualified scientists according to scientific merit, available facility time, and level of resources.

For More Information

Contact the Director, National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307.

UPPER ATMOSPHERIC FACILITIES (UAF)

UAF consists of four large incoherent-scatter radar facilities located along a longitudinal chain from Greenland to Peru. In response to a need for more understanding of global-scale thermospheric and ionospheric problems, these facilities have been upgraded and realigned into a chain extending from the polar cap to the magnetic equator.

The major goal of the UAF Program is to promote basic research on the structure and dynamics of the earth's upper atmosphere by:

1. Supporting the operation and scientific research of the longitudinal chain of incoherent-scatter radars.
2. Ensuring that these radars are maintained as state-of-the-art research tools available to all interested and qualified scientists.

The UAF consists of the following:

- **Sondrestrom Radar Facility** at Sondre Stromfjord, Greenland is operated by SRI Institute International under an NSF grant. This radar has recently been moved from Alaska and allows observations of the polar cap, the cusp (a region of easy access for solar wind energy), and the northern part of the auroral oval.

- **Millstone Hill**, near Boston, Massachusetts, is operated by MIT's Haystack Observatory under an NSF grant. It is located south of the auroral oval, in the region where significant mid-latitude phenomena are observed. Observations of high-altitude regions—from almost directly above the radar at Sondre Stromfjord to almost directly above the next radar in the chain at Arecibo, Puerto Rico—can be made there.

- **Arecibo Observatory** at Arecibo, Puerto Rico is operated under contract to the NSF by the National Astronomy and Ionosphere Center of Cornell University. At Arecibo's latitude scientists have obtained evidence for particle precipitation into the atmosphere, composition changes

in the atmosphere after magnetic storms, gravity waves propagating from the auroral region, and the penetration of magnetospheric electric fields.

• **Jicamarca Radio Observatory**, at the magnetic equator in Jicamarca, Peru, is operated under an NSF grant to Cornell University and subcontract to the Instituto Geofisico de Peru. At this low latitude evidence has been found for the penetration of magnetic fields.

In addition, UAF supports the High-Frequency (HF) heating facility site at Arecibo Observatory. This facility uses the ionosphere as a gigantic plasma physics laboratory, artifically injecting energy into the ionospheric medium to study plasma wave processes.

To increase the effectiveness of the radar chain and enhance its scientific usefulness to the community, a database supported by UAF has been established at NCAR. The database has already begun receiving data from the radars in the chain and will make available the pertinent data, in the form of geophysically meaningful parameters, to all interested members of the scientific community.

Eligibility

UAF-supported facilities are available on a competitive basis to all qualified scientists. Use is based on scientific merit of the proposed research, capabilities of the radars to carry out the proposed observations, and availability of the requested time.

For More Information

Contact the following:

Director, Sondrestrom Radar Facility, Radio Physics Laboratory, SRI International, Menlo Park, California 94025

Director, Millstone Hill Radar, MIT, Haystack Observatory, Westford, Massachusetts 01886

Director, NAIC (for Arecibo Observatory), Cornell University, Ithaca, New York 14853

Jicamarca Radio Observatory Project, Department of Electrical Engineering, Cornell University, Ithaca, New York 14853.

Earth Sciences

The Earth Sciences program aims to increase understanding of the earth's evolution from its beginning to the present and of its chemical and physical properties and processes. Results of this research show the chemical and physical relationships that produce landforms, mineral resources, and the environmental changes that affect human survival on this planet.

EARTH SCIENCES PROJECT SUPPORT

The program's objective is to achieve a greater understanding

about the physical structure and chemical composition of the earth and the geological processes that have led to its evolution. The focus is primarily on the constitution of the earth's lithosphere, which includes the upper mantle, crust, continents, and plates. Emphasis is on the application of plate tectonics to the study of the origin and evolution of continents. Research in geology, geophysics, geochemistry, petrology, and related fields contributes to an understanding of how the planet works; it also provides fundamental knowledge leading to advances in mineral and energy resources development, mitigation of geologic hazards, and better maintenance of the environment.

Eligibility

Proposals may be submitted by academic institutions, nonacademic and nonprofit research organizations, profitmaking and private research organizations, and individuals.

Deadlines: Proposals will be accepted at anytime.

For More Information

Contact the Division of Earth Sciences, National Science Foundation, Washington, D.C. 20550.

Areas of Research

• **Stratigraphy and Paleontology**—Sedimentary rocks and fossils are used as a framework to interpret past conditions and processes active on the earth's surface. Includes sedimentology, biostratigraphy, paleolimnology, micropaleontology, paleoecology, and vertebrate and invertebrate paleontology.

• **Surficial Processes**—Physical and chemical processes active at or near the earth's surface. Research includes geomorphology and quaternary geology, low-temperature geochemistry, surface waters and groundwaters, glaciology, soil genesis and classification, fossil fuel generation, and study of geologic hazards.

• **Crustal Structure and Tectonics**—Investigation of rock deformation and deformation mechanisms by field, laboratory, and theoretical techniques. Investigation includes reconstruction of past crustal plate configurations, and use of techniques from structural geology, mapping, seismology, geochronology, and paleomagnetic dating.

• **Seismology**—Nature and occurrence of earthquakes, the propagation of seismic waves within the earth, and the use of seismological data and technique to determine the internal structure and constitution of the earth.

• **Experimental and Theoretical Geophysics**—Physical properties of the solid earth. Includes studies in geodesy, electromagnetism, paleomagnetism, convection, heat flow, and gravity, as well as theoretical and laboratory modeling of geophysical processes.

• **Petrogenesis and Mineral Resources**—Integration of laboratory, field, and experimental data to infer conditions and processes that formed crustal rocks, minerals, and ores. Studies involve igneous and metamorphic petrology, rock-water interactions, economic geology, and studies of active and fossil magma-hydrothermal sytems.

• **Volcanology and Mantle Geochemistry**—Research on all aspects of volcanology and volcanic rocks, the geochemistry and petrology of mantle samples and meteorites, and extraterrestrial materials. Use is made of geochemical and isotopic techniques, modeling, and theoretical studies to understand the orgin and chemical evolution of the earth—especially its mantle—and the planets.

• **Experimental and Theoretical Geochemistry**—Laboratory and theoretical studies aimed at a quantitative understanding of the chemical behavior of natural materials under conditions of temperature and pressure found within the earth. Includes crystallography, mineral chemistry, geochemical kinetics, silicate melts and glasses, thermochemistry, hydrothermal fluid chemistry, experimental petrology, high-pressure studies, and related theoretical work.

• **Instrumentation and Facilities**—Includes acquisition of major research equipment, renovation and upgrading of existing equipment, and the development of new instrumentation that will extend current research capabilities. Proposals may request support for regional facilities to provide access to large equipment items by a broad segment of researchers.

• **Continental Lithosphere**—Supports multidisciplinе, consortia-type research that focuses on a better understanding of the structure, composition, and evolution of the continental lithosphere. Topics proposed must have the endorsement of a major segment of the earth science community.

Ocean Sciences

This program supports research to improve understanding of the sea and the ocean basins. Basic research programs support individual scientists, small groups of cooperating scientists, and some large coordinated projects. Ocean Sciences also backs efforts to develop, acquire, and operate the instrumentation and facilities needed to carry out these research programs.

OCEAN SCIENCES RESEARCH SUPPORT

These programs fund a broad range of projects dealing with physical, chemical, geological, and biological processes in the ocean. Large and small grants of several months' to several years' duration are awarded to highly qualified individuals and groups of scientists. Grants are awarded on the basis of competitive peer review of unsolicited research proposals.

Deadlines

Submit proposals at any time. Allow about six months for review and processing. Following is the annual schedule of target dates for submitting proposals and the earliest starting dates associated with proposal review panels:

Proposal Target Date	Start Date (earliest)
June 1	Nov. 1
Oct. 1	Jan. 1
Feb. 1	July 1

Proposals that require the use of ships (see "Oceanographic Facilities Support" below) should be submitted by the February 1 (preferred) or the June 1 target dates, so that timely decisions can be made on ship support and schedules.

For More Information

Contact the Director, Division of Ocean Sciences, National Science Foundation, Washington, D.C. 20550.

Areas of Research

• **Physical Oceanography**—Description, analysis, and modeling of oceanic circulation and transport; effects of circulation on energy momentum transport; physical circulation processes, eddy generation, and turbulent

mixing on continental shelves; mixing processes and circulation in estuaries; wind-generated tides and surface and internal waves; small-scale transport processes such as diffusion, conduction and convection, and three-dimensional turbulence; physical properties of seawater; circulation and mixing processes in lakes.

• **Marine Chemistry**—Physical and chemical properties of seawater; equilibria of chemical species and compounds in seawater; fluxes between seafloor sediments, their interstitial waters, and overlying seawaters; fates of materials deposited on the sea floor; alterations of material moving through the ocean; interactions and interdependencies between chemical processes and marine organisms; air-sea exchanges of manmade and naturally mobilized chemicals; chemical properties of the ocean surface; kinetic and thermodynamic processes in the marine environment.

• **Submarine Geology and Geophysics**—Structure of continental margins, oceanic rise systems, and deep sea sedimentary basins; evolution of ocean basins; processes controlling exchanges of heat and chemical elements between seawater and oceanic rocks; tectonic and volcanic activity at mid-ocean ridges; chemical and mineralogic variations in marine sediments; deposition, erosion, and distribution of marine sediments; geologic and oceanographic processes controlling sedimentary systems; past oceanic circulation patterns and climates; evolution of microfossil groups; paleoenvironmental controls on fossil groups and sediment types; interactions of continental and oceanic geologic processes.

• **Biological Oceanography**—Distribution, abundance, physiology, and life history of pelagic, coastal, and deep sea marine organisms, and their interactions with their environments; structures of pelagic and detritus-based food chains; phytoplankton productivity; interactions between deep sea biological processes and the ocean ecosystem; specialization of deep sea organisms; ecology of the Great Lakes and factors regulating phytoplankton productivity there.

OCEANOGRAPHIC FACILITIES SUPPORT (OFS)

The National Science Foundation supports construction, conversion, acquisition, and operation of shared-use major oceanographic facilities. The University-National Oceanographic Laboratory System (UNOLS) schedules the use of these facilities as well as expeditionary programs.

This program supports large and expensive facilities that will aid NSF-funded research and training of oceanographers. Examples of these facilities are ships, submersibles, large shipboard equipment, and complex instruments to collect and analyze data. Funds are also available to develop research instrumentation that has potential for wide use. However, the award of such funds does not imply continuing facility support.

The Foundation encourages local contributions from non-Federal funds; however, there is no fixed requirement for institutional contributions.

Eligibility

OFS support for major oceanographic facilities is concentrated at a few institutions that are suitably located and have the capability to operate major facilities. These institutions have substantial ongoing programs of primary research in oceanography; they also support the programs of other institutions.

Before submitting a proposal for support under this program, institutions should seek advice from the Oceanographic Facilities Support Section. Specific instructions on how to submit proposals for ship operations, technicians, shipboard equipment and oceanographic instrumentation are available.

Deadlines and Target Dates

Proposals for ship operations and technicians are due July 1 each year. Proposals for shipboard equipment and oceanographic instrumentation are due September 1 each year. Target dates for instrumentation development proposals are September 1 and February 1 each year. Proposals requesting support for other activities may be submitted at any time.

For More Information

Contact the Division of Ocean Sciences, Oceanographic Facili-

ties Support Section, National Science Foundation, Washington, D.C. 20550.

OCEAN DRILLING

Ocean drilling activities are a unique, international effort to explore the earth's crust beneath the oceans. This interdisciplinary science effort seeks to reveal the composition, structure, and history of the submerged portion of the earth's surface. Ocean drilling involves collecting geologic samples from the floor of the deep ocean basins through rotary coring and hydraulic piston coring in the sediments and underlying crystalline rocks. Samples of these cores are made available to qualified scientists throughout the world for individual research projects.

DEEP SEA DRILLING PROJECT (DSDP)

After 15 years of pioneering service, field operations of the DSDP concluded in November 1983 with demobilization of the drilling vessel *Glomar Challenger*. Based at the Scripps Institution of Oceanography, University of California at San Diego, the DSDP drilled at 624 ocean sites throughout the world and has contributed to major advances in our understanding of global tectonics, the composition of ocean crust, evolution of ocean basins and margins, and the history of global paleoenvironments.

Core descriptions and resulting interpretations are published in a series of volumes called the *Initial Reports of the Deep Sea Drilling Project* (one volume for each cruise). The reports are placed with all major libraries and available for purchase from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

OCEAN DRILLING PROGRAM (ODP)

The new ODP, like its predecessor the DSDP, is an international program dedicated to the exploration of the ocean crust and the sediments of the ocean basins and margins. Scientific planning on the international level has been in progress for several years and a new drilling vessel, the *SEDCO/BP 471*, has been selected for the drilling effort through the next decade. Field operations with the new vessel will be managed by Texas A&M University and are scheduled to begin in Fiscal Year 1985. The general contractor for the overall management and operation of the ODP is Joint Oceanographic Institutions, Inc., a consortium of major U.S. oceanographic institutions.

Support for participation and drilling-related research performed by U.S. scientists is provided by NSF. This support focuses on investigations of potential drilling regions, including studies that combine aspects of continental and marine geoscience; downhole geophysical experiments and development of related instrumentation; and workshops and other activities focusing on problem definition prior to drilling operations. To be considered for support, proposed projects must be clearly relevant to the drilling plans of the international community.

Deadlines

Submit proposals at any time during the year. Allow about six months for review and processing.

For More Information

Contact the Ocean Drilling Program, Division of Ocean Sciences, National Science Foundation, Washington, D.C. 20550.

Proposals for drilling specific sites should be submitted to JOIDES Planning Committee Chairman, c/o Joint Oceanographic Institutions, Inc., 2100 Pennsylvia Avenue, N.W., Suite 316, Washington, D.C. 20037.

Send requests for samples of core material to the Curator, Ocean Drilling Program, Texas A&M University, College Station, Texas 77843.

Polar-Programs

U.S. ANTARCTIC RESEARCH

The National Science Foundation awards grants or contracts for research in and around Antarctica and for antarctic research at home institutions.

The goal of the U.S. Antarctic Research Program is to maintain the Antarctic Treaty to ensure that the continent will be used for peaceful purposes, to foster research that contributes to the solution of regional and worldwide problems, to protect the environment, and to ensure equitable and wise use of resources. Research is supported in the disciplines of biology and polar-related medicine, upper atmosphere physics, geology, glaciology, meteorology, and oceanography.

Specific objectives of the program are to understand the function, evolution, and adaptations of land and sea species and ecosystems; the geology and geologic history of the continent and its surrounding ocean basins; the structure and dynamics of the magnetosphere and the ionosphere, which are uniquely measurable at the high geomagnetic latitudes of Antarctica; Antarctica's role in past and present global climate through study of surface and upper air processes, the structure, dynamics, and chemistry of the ice sheet, and oceanic circulation; and the physical and chemical oceanography of antarctic seas.

Research may be performed at three U.S. research stations: Palmer (65°S. 64°W.), Amundsen-Scott South Pole (90°S.), and McMurdo (78°S. 167°E.). Each station has laboratories or specialized equipment and adequate for comfortable residence. Work may also be done aboard the ice-strengthened research ship *Polar Duke*, Coast Guard icebreakers, a research ship of the U.S. academic fleet, and a research-configured LC-130 airplane. During the austral summer, research may be done at camps at almost any continental location. Occasionally, such work may be carried out at stations of other Antarctic Treaty nations.

From early October to late February, there is frequent air service between the United States and all stations except Palmer, which is serviced by *Polar Duke* and other ships between December and April. Also, flights generally are made to McMurdo in late August. For the rest of the year the stations operate in isolation.

A brochure (NSF 82-34) further describes the program; sets forth research opportunities and objectives; describes facilities, logistics, and other support available to investigators; and explains how to prepare proposals. An investigator must get a copy of this brochure and a propocal preparation kit from the Division of Polar Programs before writing a proposal.

Eligibility

U.S. academic institutions and academically related nonprofit organizations may submit proposals for grants or contracts for research project support. Industry and other local, State, and

Federal agencies also are eligible for support.

Target Dates

Requests for support of research should be received by June 1 of the year preceding the proposed commencement of field work. For example, proposals for the 1986-1987 austral summer and the 1987 austral winter should be received by June 1, 1985. Scientists must specify their logistics needs in their proposals. They also must use a proposal preparation kit containing a copy of the brochure mentioned above plus other essential forms and instructions.

For More Information

Investigators will be aided in preparing proposals by the brochure and proposal preparation kit referred to above, by the Foundation's brochure *Grants for Scientific and Engineering Research* (NSF 83-57), and by preliminary communication with the Polar Science Section and, for field work, the Polar Operations Section of the Division of Polar Programs.

Literature published between 1951 and the present is cited in the multivolume *Antarctic Bibliography*, available from the U.S. Government Printing Office, Washington, D.C. 20402. Literature published before 1951 is listed in *Antarctic Bibliography* (1968, Greenwood Press, Westport, Connecticut 06880). The monthly *Current Antarctic Literature* is available through the Division of Polar Programs.

Knowledge of Antarctica is summarized in the *Antarctic Map Folio Series* (Smithsonian Oceanographic Sorting Center, Washington, D.C. 20560). Maps of the continent are available from the U.S. Geological Survey, 1200 S. Eads Street, Arlington, Virginia 22202.

Ice cores, ocean-bottom sedimentary cores, terrestrial sedimentary cores, dredged rocks, biological specimens, meteorites, and ocean-bottom photographs are available for study. Request "Specimen and Core-Sample Distribution Policy" from the Division of Polar Programs.

Address communications to the Division of Polar Programs, National Science Foundation, Washington, D.C. 20550.

ARCTIC RESEARCH

Within the Arctic Research Program, the Foundation supports both individual research and large multidisciplinary projects. The program has rather specific objectives; these are described briefly below and at greater length in a brochure (NSF 82-33) available from the Division of Polar Programs.

The Arctic Research Program comprises only about half of the arctic-related research supported by the National Science Foundation. Investigators planning to propose research within a given discipline should examine other NSF programs to determine which have research objectives most closely related to their projects. Research is supported in the disciplines of geology and geophysics, biology, oceanography, meteorology, glaciology, and upper atmosphere physics.

Specific objectives of the program are to gain new knowledge on mechanisms of energy transfer between the magnetosphere, the ionosphere, and the neutral atmosphere; the role of the Arctic Basin in influencing climate; the interactions of arctic and subarctic seas with the global ocean system; sea-ice occurrence and behavior in coastal waters; the history of climatic changes as revealed in the study of deep ice cores from the Greenland ice sheet; properties and characteristics of permafrost; and the structure, function, and regulation of arctic terrestrial and marine ecosystems.

The Foundation generally does not provide logistics or operational support for arctic research; it is usually the responsibility of the proposers to arrange and budget for these items. However, NSF sometimes arranges for aircraft support and housing for research in Greenland.

Prior approval by the Danish government is needed for research in Greenland. Approval involves formal submittal by the U.S. Government of project descriptions and an oral presentation to Danish officials. Scientists contemplating research in Greenland should contact the Division of Polar Programs as early as possible.

Eligibility

U.S. academic institutions and academically related nonprofit research organizations may submit proposals for grants or con-

tracts for research project support. Industry and State and local government agencies also are eligible for support.

Target Dates

Requests for support of research should be received by September 1 for support in the following fiscal year, which lasts from October 1 to September 30. In all proposals involving field work, scientists must specify their logistics and operational plans, to assure safety and feasibility.

For More Information

Investigators will be aided in the preparation of proposals through use of the brochure referred to above; use of the NSF brochure *Grants for Scientific and Engineering Research* (NSF 83-57); and preliminary communication with the Polar Science Section and, for major field work, the Polar Operations Section of the Division of Polar Programs.

Greenland ice cores are available for study. Contact the Department of Geology, State University of New York at Buffalo, Amherst, New York 14226.

A 1:5,000,000-scale map of the Arctic, published in 1975, is available from the Smithsonian Oceanographic Sorting Center, Washington, D.C. 20560.

The *Arctic Bibliography* (16 volumes, 1953-1975, Arctic Institute of North America, Calgary, Alberta, Canada T2N 1N4) abstracts and indexes 108,000 titles relevant to the Arctic.

Address communications to the Division of Polar Programs, National Science Foundation, Washington, D.C. 20550.

5

SCIENCE AND ENGINEERING EDUCATION

GRADUATE FELLOWSHIPS

This program promotes the future strength of the Nation's scientific and technological base by providing recognition and support for advanced study to outstanding graduate students in all fields of science and engineering. Fellows are selected in a national competition on the basis of actual and potential achievements in their chosen disciplines. They may pursue their studies at any appropriate United States or foreign institution of higher learning. Approximately 540 new awards will be made this year; each gives up to three years of support for full-time graduate study.

Eligibility

To be eligible for this nationwide merit competition, candidates must be citizens or nationals of the United States and at or near the beginning of their graduate study.

Beginning with FY 1985 awards, the stipend for each fellow is $11,100 for a 12-month tenure, prorated for lesser periods; in lieu of tuition and fees an annual cost-of-education allowance of $6,000 is made available to the awardee's institution for each year of tenure.

Deadlines

The deadline for applying is November 21, 1984. NSF will notify all applicants as to the outcome of their applications in mid-March 1985.

For More Information

A detailed program description and guidelines for applications are in the brochure *Graduate Fellowships Announcement* (NSF 84-47). Order it from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, D.C. 20418.

MINORITY GRADUATE FELLOWSHIPS

This program was established in fiscal year 1978 to give fellowship support to members of ethnic minority groups whose abilities traditionally have been untapped in the advanced levels of the Nation's science talent pool. Under this program, support goes to outstanding minority graduate students for study or work toward master's or doctoral degrees in science and engineering. Each award provides up to three years of support for full-time graduate study. It is anticipated that approximately 60 new fellowships will be awarded this year.

Eligibility

Competition in this program is open to citizens or nationals of the United States who are American Indian, Black, Eskimo or Aleutian, Pacific Islander, or Hispanic, and who are at or near the beginning of their graduate study. Starting in FY 1985, the stipend for each fellow is $11,100 for a 12-month tenure, prorated for lesser periods. In lieu of tuition and fees, an annual cost-of-education allowance of $6,000 is made available to the awardee's institution.

Deadlines

The deadline for applying is November 21, 1984. NSF will notify all applicants as to the outcome of their applications in mid-March 1985.

For More Information

A detailed program description and guidelines for applicants are in the brochure *Minority Graduate Fellowships Announcement* (NSF 84-46). Order it from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, D.C. 20418.

NATO POSTDOCTORAL FELLOWSHIPS IN SCIENCE

To promote the progress of science and to aid a closer collaboration among the scientists of various nations, the North Atlantic Treaty Organization sponsors a program of NATO Postdoctoral Fellowships. At the request of the Department of State, the Foundation administers this program for NATO. Approximately 50 awards will be made in fiscal year 1985 to outstanding individuals who have received, or will soon receive, doctoral degrees in science or engineering (or the equivalent of those degrees in research training and experience).

Eligibility

Awards are made to U.S. citizens for full-time postdoctoral study in countries that are members of NATO (other than the United States) or in neighboring countries that cooperate with NATO. This program is designed for applicants who have received their doctorate within the past 5 years. The stipend for a NATO Postdoctoral Fellow is $1,500 per month; tenures generally range from 9 to 12 months. Normally, a fellow is also provided with some dependency allowances and aid in defraying the costs of travel.

Deadlines

Applications are due at the Foundation by November 2, 1984. Fellowship awards are expected to be announced in late February 1985.

For More Information

A detailed program description and guidelines for applications are in the brochure *NATO Postdoctoral Fellowships in Science* (NSF 84-38). Contact the Office of Research Career Development, Directorate for Science and Engineering Education, NSF, Washington, D.C. 20550.

TRAVEL GRANTS FOR NATO INSTITUTES

The Foundation awards travel grants, normally covering the round-trip economy air fare involved, to enable young U.S. scientists to attend certain NATO Advanced Study Institutes abroad. These meetings are usually held during the summer and normally last two to three weeks.

Eligibility

U.S. citizens who are graduate science students or have received a Ph.D. within the past five years and been accepted at a NATO Advanced Study Institute may be nominated by the director of the institute. Therefore, individuals should make their interest in a NATO Travel Grant known to the director of the institute to which they have been admitted. Lists of institutes are available from the Foundation in early March, at which time information about application procedures will be made available.

PRESIDENTIAL YOUNG INVESTIGATOR AWARDS

The National Science Foundation offers cooperative research support for the Nation's most outstanding and promising young science and engineering faculty. Awards are to help universities

respond to the demand for highly qualified scientific and engineering personnel for academic and industrial research. The minimum award is $25,000, and an additional $37,500 is available from NSF on a dollar-for-dollar matching basis with contributions from industrial sources. The awardee's institution is responsible for the full academic-year salary. The Foundation expects to make 200 of these awards in fiscal year 1985.

Eligibility

U.S. institutions granting doctorates in fields supported by the Foundation are invited to nominate outstanding faculty members who are in the early stages of their careers, promising graduate students, or their recent postdoctoral recipients. Nominees must have received their doctorates after January 1, 1980. Also eligible for nomination: Scientists and engineers who received their doctoral degrees in 1979 and have had at least one year of postdoctoral, full-time industrial employment, or who received their doctoral degrees in 1978 and have had at least two years of postdoctoral, full-time industrial employment. Graduate students currently nearing their doctorate degrees, postdoctoral students, and other recent doctoral recipients without faculty affiliation may be nominated for candidate awards tenable at an appropriate eligible institution. Citizens or nationals of the United States and permanent residents are eligible to receive these awards.

Those nominated may do research in any branch of science and engineering. Emphasis will be on those fields where there are substantial needs for faculty development.

Deadline

The application deadline for fiscal year 1985 awards was July 2, 1984. Next year's deadline will be announced in the NSF *Bulletin*.

For More Information

Request the program announcement NSF 84-24. Contact the Presidential Young Investigator Awards, NSF, Washington, D.C. 20550.

PRECOLLEGE MATERIALS DEVELOPMENT AND RESEARCH

This program addresses the need to develop teacher capabilities in the critical areas of mathematics and science and to improve the instruction of students. Projects for teachers and instruction at all precollege levels, from kindergarten through the twelfth grade, will be supported through nationwide competition in these areas:

Models and demonstrations of programs for continuing teacher education.

Development of materials—such as teaching aids, computer programs, software and systems, and television-based materials—to improve science and mathematics teaching.

Analysis of the precollege science and mathematics educational system.

Dissemination of ideas and materials to sustain high-quality precollege science teaching.

Applied research to show how the teaching and learning of precollege science and mathematics can be more effective.

To be considered for NSF support, projects must deal with issues of national rather than local importance and should contribute to a continuing supply of U.S. scientific and technical personnel. The results or products must be general enough to be of use beyond the immediate locale where they were developed.

Eligibility

Although colleges and universities are expected to submit most proposals, those from other institutions with an education mission will also be considered. (See *Grants for Scientific and Engineering Research*, NSF 83-57, "Who May Submit" section.)

Deadlines

Submit proposals at any time.

For More Information

A detailed program description is in the brochure *Precollege Science and Mathematics Educa-*

tion (NSF 83-97). It must be used in conjunction with NSF *Grants for Scientific and Engineering Research* (NSF 83-57). Order both from Forms and Publications, National Science Foundation, Washington, D.C. 20550.

PRECOLLEGE TEACHER DEVELOPMENT AND INCENTIVES

Excellent teachers are at the core of good education at any level, but in precollege mathematics and science they are in short supply. There is an urgent need to attract highly talented men and women to mathematics and science teacher careers, develop teacher capabilities in these critical areas, and keep good instructors in the school systems. This means devising incentives, such as greater public recognition of the profession, and putting new emphasis on the important contributions teachers make to the Nation.

The basic goal of this program is to motivate and increase the capabilities of precollege mathematics and science teachers and thereby improve their instruction of students. Projects will be considered for teachers of all precollege levels, from kindergarten through grade twelve.

Project Activities

Projects to be supported are those developed with the cooperation of appropriate individuals and groups; they should emphasize the following activities:

Identifying and selecting science and mathematics teachers of proven high-quality performance and assuring their recognition and prestige with certificates of honor and appropriate publicity.

Establishing workshops with specialized training, practical experience, and leadership training in important areas of science, mathematics, and technology.

Developing workshop materials.

Extending the impact of workshop benefits when participants take new materials and information back to their colleagues.

Having workshop participants jointly identify and document current trends and problems in science education.

Workshops may vary in length according to the type of activity and the nature of participants. They could take place during the academic year, in the summer, or both.

Local and Regional Programs

Developing local or regional programs to provide continuing education and professional development and opportunities for precollege science and mathematics teachers.

Eligibility

Although colleges and universities are expected to submit most proposals, those from other institutions with an education mission will also be considered. (See *Grants for Scientific and Engineering Research*, NSF 83-57, "Who May Submit" section.)

Deadlines

Submit proposals at any time.

For More Information

A detailed program description is in the brochure *Precollege Science and Mathematics Education* (NSF 83-97). It must be used in conjunction with NSF *Grants for Scientific and Engineering Research* (NSF 83-57). Order both from Forms and Publications, National Science Foundation, Washington, D.C. 20550.

COLLEGE SCIENCE INSTRUMENTATION PROGRAM (CSIP)

To assure the achievement and maintenance of strong, high-quality science and engineering programs among the predominantly undergraduate colleges of the United States, this program will provide matching support for the purchase of laboratory and instructional equipment. Any four-year college or university that offers instruction in the sciences leading to the baccalaureate degree, and does not award the Ph.D. degree in any of the eligible fields of science and engineering, may apply.

Proposals will be accepted for sums from $5,000 to $50,000, to be matched with equal or greater contributions by the grantee institutions. Awards under this program will normally be made for two years, and the equipment

requested will become a permanent acquisition of the institution.

The deadline for the receipt of proposals is January 11, 1985. A more detailed program description is in NSF brochure 84-66. Order from Forms and Publications, National Science Foundation, Washington, D.C. 20550 or write: Directorate for Science and Engineering Education, National Science Foundation, Washington, D.C. 20550.

POSTDOCTORAL RESEARCH FELLOWSHIPS IN MATHEMATICS

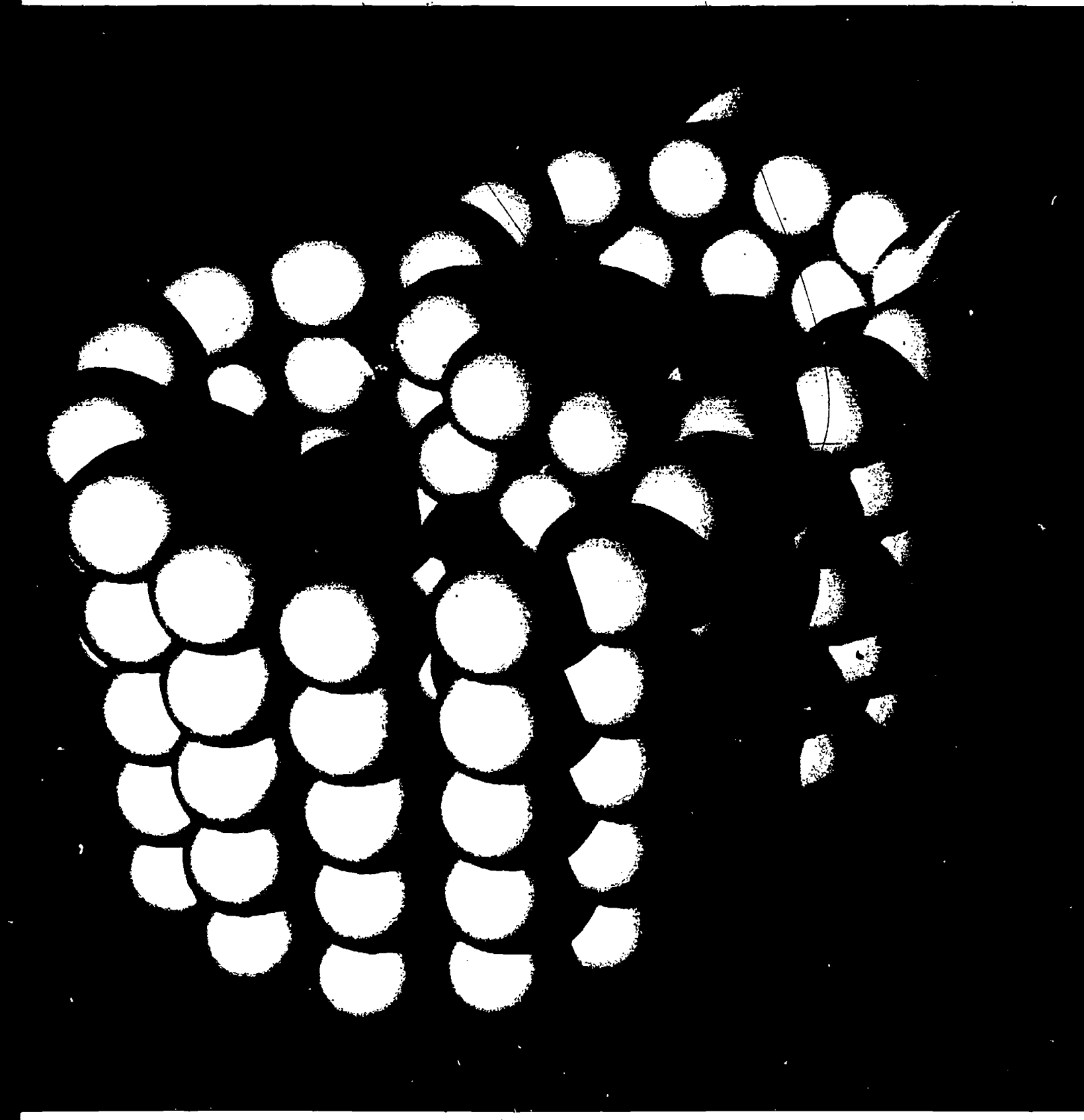
(See chapter 1.)

DOCTORAL DISSERTATION RESEARCH IMPROVEMENT GRANTS

(See chapter 7, "Other Activities.")

POSTDOCTORAL FELLOWSHIPS IN PLANT BIOLOGY

(See chapter 3.)



6

SCIENTIFIC, TECHNOLOGICAL, AND INTERNATIONAL AFFAIRS

Industrial Science and Technological Innovation

This category of programs combines NSF activities designed to:

1. Foster cooperation among different sectors of research performers and users (for example, universities and industry) and encourage private sector contributions to the national research effort.
2. Promote healthy international relationships and enhance the work of U.S. researchers by aiding cooperative activities with foreign scientists and institutions.
3. Study science and technology policy issues; provide information and analysis for public policies designed to improve the Nation's scientific enterprise and its service to society.
4. Collect, analyze, and publish data on the status of the Nation's science and engineering resources.
5. Extend greater research opportunities to all segments of the scientific community.

Programs for Industrial Science and Technological Innovation support cooperative work between universities and industry, and between scientists/engineers and the general public. The programs also provide opportunities for small business innovation research.

Research Initiation and Improvement programs initiate and support research and related activities that strengthen the resource base for science and engineering and cut across the Foundation's discipline-oriented activities.

International Cooperative Scientific Activities support joint efforts with advanced and developing countries.

Policy Research and Analysis and Science Resources Studies provide research, analysis, and reporting on the overall scientific and technological enterprise and its impact on society.

Areas of Research

The National Science Foundation has always been acutely aware of the relationships between industrial development, technological innovation, and scientific research. These programs focus on those relationships, stressing cooperation be-

tween industry and universities. They also improve the Foundation's ability to address issues often raised by the Congress, by the science and technology policy community, and by industry.

Industrial Science and Technological Innovation programs support cooperative research efforts between the Nation's universities and industry and research in small, high-technology businesses. The long-term goal is to improve technological innovation. Specific objectives are to:

- Improve the linkage between university and industrial fundamental research by supporting joint research projects.
- Increase opportunities for small S&T firms to do research leading to rapid commercialization of new products and processes.
- Help to create university research centers where industrial and university scientists and engineers may work together on technologies of industrial relevance that have potential applications across major sectors of the economy.
- Improve understanding of the management of technological change and analyze alternative strategies for the productive use of technology.

INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH PROJECTS

Here the objective is to advance scientific and engineering knowledge that is a key to future technological innovation, by encouraging cooperative industry and university research.

To identify basic research that is relevant to innovation, NSF sponsors nonproprietary cooperative research projects between universities and industry. These projects focus on technological opportunities important to the Nation, and the length of time in translating fundamental knowledge into economic utility is shortened.

Eligibility

Eligible institutions are universities and colleges and established profit-making industrial firms, including small businesses. The cooperating parties must represent bona fide independent operations, as evidenced by the absence of interlocking relationships. Prior or current consulting relationships between faculty and industrial firms are acceptable as long as these relationships do not materially affect the *major* decision-making ability of either institution or the objectivity of the research results.

Proposals should be prepared jointly by academic and industrial researchers and submitted jointly by their respective institutions.

Award Criteria

Eligibility criteria:

1. Strong and active research collaboration between university and industrial researchers in doing the proposed project.
2. Significant cost-sharing by the industrial participant of its own costs of research participation, as evidence of the industrial relevance of the research.

Selection criteria:

1. Quality of proposed research.
2. Likelihood that successful research will have important implications for technological advances.
3. Appropriate mix of cooperative projects across the specialties of science and engineering.

To ensure high technical quality, proposals will be peer-reviewed in competition with other proposals (cooperative and noncooperative) in the same area of research. These review procedures are the same as those applied to any research proposals received by NSF.

Preparation and Submission of Proposals

All grants made by this program will be jointly sponsored by at least one other NSF program. Accordingly, each proposal should identify two NSF programs on its cover page: (1) Industry/University Cooperative Research Projects Program and (2) another NSF program in which the proposed research falls. For example, a grant in chemistry might be jointly sponsored by the NSF Chemistry Division and by this program.

Researchers should submit a cooperative proposal directly to the NSF technical program re-

sponsible for the area of research.

The phrase "Industry/University Cooperative Research" should be placed on the title page above the proposal title. The research plan should explain the tasks to be performed by both the university and industrial groups.

Projects will be technically reviewed, recommended, co-funded, and monitored by the relevant technical program.

The proposal should be prepared according to instructions in the NSF booklet *Grants for Scientific and Engineering Research* (NSF 83-57), available from Forms and Publications, National Science Foundation, Washington, D.C. 20550.

Deadlines

There are no specific closing dates. Allow about six months between receipt of proposals and notice of funding decision.

For More Information

Ask for the program announcement *Industry-University Cooperative Research Grants* (NSF 82-56).

Contact Program Director, Industry/University Cooperative Research Projects, National Science Foundation, Washington, D.C. 20550, (202) 357-7784 or 357-7527.

INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTERS

The Foundation also encourages another kind of linkage called Industry/University Cooperative Research Centers. In contrast with the cooperative research projects, the centers are not based on a one university-one company relationship. Instead, they are based on a one university-multicompany arrangement that focuses on particular scientific areas—for example, polymer processing or computer graphics. Companies may be from one or several industries. Promising variations on these arrangements are also considered.

A center of this type usually calls on the services of many disciplines within a university, especially those concerned with the business and engineering schools. It also invites participation by local business and financial communities. Six to twelve private-sector companies are generally associated with a center as co-sponsors of R&D programs that are of interest both to companies and the university.

The programs cover basic and applied research in various scientific disciplines and generic technologies that have prospects of leading to new products, processes, and services for the participating companies. Generally the research agenda is established by the participants and is not subject to NSF control.

NSF and industry's joint support in launching a center lets the university develop a broad-based research program that can respond to the scientific needs of industry and test the ongoing interest and commitment of the industrial sponsors.

After a planning and organizing period of about one year, funded usually at a level of $50,000 to $75,000, the annual budget of a typical center (including some government and private funds) is normally around $300,000 to $500,000. At first it is co-funded with industry by NSF (about half of all costs), but the center is expected to become self-sufficient within five years. As the center research programs mature, industry acceptance and support grow while NSF support is phased out.

Eligibility

Universities, colleges, profit-making industrial firms, foundations, nonprofit organizations, and combinations of the above are eligible.

Award Criteria

Awards are primarily based upon quality of the work effort proposed and the ability of the center to achieve self-sufficiency within a three- to five-year period. Self-sufficiency is defined as receiving a minimum of 80 percent private-sector support.

Awards are made under a two-phase system. The first-phase funding can be as much as $100,000 for a maximum of 18 months; this gives NSF the opportunity to evaluate the capabilities of the center for establishing a productive long-term, university-industry relationship. This phase also provides time for the university/industry team to determine whether it wishes to continue the program. By the end of this initial phase, a firm plan for achieving self-sufficiency should be in place,

with the cost-sharing relationship between industry, university, and Government established.

Second-phase funding is contingent upon achieving the first-phase objectives. Such an award usually would not exceed $1 million over a three- to five-year period, with the NSF share being provided on a decreasing annual basis according to a planned schedule. Private-sector funding would increase proportionally over this same period and end up at a higher level than the NSF annual commitment.

In addition to the primary criteria for center funding—technical quality of the proposal, qualifications of the proposers, and the likelihood of achieving the stated objectives—the evaluators will also consider the extent to which:

- Activities will result in the involvement of undergraduate and graduate students with industry and its problems. (Generally, graduate thesis projects are developed and refereed journal articles are published as a consequence of the research.)
- University researchers will be allowed access to research facilities and resources normally available only to industry researchers and, in some cases, vice versa.
- Proprietary rights and publication needs of the participants in all experiments and projects will be clearly defined.

Preparation of Proposals and Budget

Proposals and budget should be prepared and submitted according to the guidelines and format in the NSF publication *Grants for Scientific and Engineering Research* (NSF 83-57), available from the Forms and Publications Unit, National Science Foundation, Washington, D.C. 20550.

Deadlines

There are no specific closing dates. Allow about six months between receipt of the proposal and the final decision.

For More Information

Contact the Program Director, Industry/University Cooperative Research Centers, National Science Foundation, Washington, D.C. 20550. (202) 357-7527.

SMALL BUSINESS INNOVATION RESEARCH PROGRAM

This program offers an opportunity and incentive for small, creative science- and technology-oriented firms. They may do innovative high-risk research on important scientific and technical problems—work that could have significant public benefit if the research is successful. The program meets the requirements of the Small Business Innovation Development Act of 1982 (P.L. 97-219).

This is a three-phase program that offers incentives for converting research done in phases I and II to commercial applications in phase III, with the last effort funded by private-venture capital. Phase I awards, at a maximum of $40,000, are made to determine whether a research-based idea seems technically feasible, and whether the proposing firm can do high-quality research. Phase II funds those research projects found most promising at the end of phase I; previous phase II awards have averaged $100,000 a year for up to two years. No NSF support is involved in phase III.

One objective of this program is to increase the return on investment to the public from federally funded research. A key part of this effort is to encourage a commitment for phase III financing by a third party before NSF funds phase II. The commitment is effective only if phase II achieves certain mutually agreed-upon technical objectives. Phase III financing introduces early private-sector funding and indirectly couples the NSF-supported research to outside evaluations of the potential market, management, and financial requirements.

Research topics may range from engineering and the physical sciences to the life sciences, with emphasis on advanced research concepts that could serve as a basis for technological innovation. The mix of topic areas will differ somewhat with each solicitation for proposals.

Eligibility

Eligibility is restricted to small business firms—those organized for profit, individually owned or operated, not dominant in the

field in which they are bidding, and having an average of not more than 500 employees in all affiliated firms. In addition, the primary employment of the principal investigator must be with the small business firm at the time of award.

Deadlines

Annual solicitations made by this program are widely publicized by the Small Business Administration. They are also announced in the *Commerce Business Daily* and sent to those on NSF's small business mailing list. Solicitations list specific deadlines for proposals.

For More Information

Request the latest *Small Business Innovation Research* solicitation brochure (NSF 84-19 or its successor).

Contact the Program Manager, Small Business Innovation Research, National Science Foundation, Washington, D.C. 20550. (202) 357-7527.

PRODUCTIVITY IMPROVEMENT RESEARCH

A major objective of this program is to improve understanding of innovation processes in private and public sectors, particularly as they are affected by management practices and Federal actions. Research is supported on these topics:

- Issues related to industrial innovation, especially processes in small, high-technology firms.
- Effects of organizational structure and behavior on innovation.
- Implementation of complex innovations.
- Technology generation and diffusion, with special emphasis on manufacturing process technology.
- How universities and industrial firms successfully interact on research, development, and technological innovation.

Eligibility

Proposals may be submitted by academic institutions, nonprofit and profit-making organizations, State or local government organizations, or by a combination of the above. Especially welcome are joint proposals that involve multiple investigators and/or institutions bringing a coordinated range of expertise and research skills to bear on complex problems.

Deadlines

Submit proposals at any time during the year. Allow about three to six months for review and decision. Letters of interest describing the proposed research are encouraged before submission of a formal proposal.

For More Information

Guidelines for submitting proposals are in the brochure *Program Announcement for Extramural Research: Productivity Improvement Research*. Send requests for more information to Productivity Improvement Research, National Science Foundation, Washington, D.C. 20550. (202) 357-9804.

Research Initiation and Improvement

NSF activities in this field reflect the Foundation's unique role as the only Federal agency concerned with and able to draw upon the resources of the scientific and technical community as a whole. Program objectives include these:

- To increase opportunities for women, minority, handicapped, and young investigators and for research faculty from predominantly undergraduate colleges to participate in the Nation's scientific and engineering enterprise.
- To improve access to scientific and technical resources by institutions (including State and local governments) that presently underuse those resources.
- To help in identifying the Nation's science and engineering needs, opportunities, and problems.

SUPPORT FOR PREDOMINANTLY UNDERGRADUATE INSTITUTIONS

NSF encourages and supports research and instrumentation in academic settings where primary emphasis is on undergraduate education and where research by faculty enhances the preparation of undergraduate students for careers in science and engineering.

Faculty at predominantly undergraduate institutions are urged to submit research and instrumentation proposals to NSF's disciplinary program offices according to regular program guidelines and deadline or target dates.

In addition, NSF supports two activities directed especially at greater research involvement of the faculty at predominantly undergraduate institutions. They are the Research in Undergraduate Institutions (RUI) program and the Research Opportunity Awards (ROA) activity, both described in this section.

RESEARCH IN UNDERGRADUATE INSTITUTIONS (RUI)

This program supports faculty research in academic settings where primary emphasis is on undergraduate education and research involvement is a way to prepare undergraduate students for careers in science and engineering.

Categories of Awards

Awards are made in two categories. The first, Research Awards, supports research in two settings: (1) at the home institution, including work in the field, and (2) away from the home institution at a research university or laboratory. The second category, Research Instrumentation Awards, provides support to acquire instrumentation that is essential for faculty research.

Eligibility

Eligibility under RUI is defined in both departmental and institutional terms. Specifically, applicants must be departments that (1) offer courses leading to

a bachelor's degree in a scientific or engineering discipline, may offer master's degrees, but do not offer the doctorate; and (2) are located on campuses where the number of scientific and engineering doctorates awarded by the campus as a whole did not exceed a total of 20 in fields of science and engineering supported by the NSF during the two calendar years before the proposal submission date.

Award Criteria

Research under this program is fully integrated into other research activities supported by the Foundation. Each RUI grant application must propose a specific faculty research project that will be evaluated by the NSF disciplinary program according to the four criteria stated at the beginning of this *Guide*. There will be a special emphasis on the fourth criterion—effect of the research on the infrastructure of science and engineering—in terms of the proposed project's potential for better integrating the research and training function and for enhancing the submitting department's ability to prepare students for entry into doctoral education and careers in science and engineering.

Deadlines

Proposals may be submitted at any time. Allow six to nine months for proposal review. Some NSF disciplinary programs publish target dates for submission of proposals in the NSF *Bulletin*. These dates are applicable for RUI proposals. Proposals received too late for consideration in a particular fiscal year (ending September 30) are considered in the following year.

For More Information

Prospective applicants should request from the RUI coordinator the brochure NSF 83-79, *Research in Undergraduate Institutions: Program Announcement*, and should refer to the appropriate disciplinary program section of this *Guide*.

Applicants are also urged to discuss guidelines with the NSF program officer in their research discipline before submitting a formal proposal to the Foundation. General inquiries should be addressed to RUI Coordinator, National Science Foundation, Washington, D.C. 20550. (202) 357-7456.

RESEARCH OPPORTUNITY AWARDS (ROA)

The Foundation provides opportunities for faculty at predominantly undergraduate institutions to participate in research under the aegis of NSF investigators at research institutions.

Faculty members make their own arrangements with investigators at the research universities or laboratories who have been awarded, or are currently applying for, a Foundation research project grant. Grantees who wish to employ faculty under these arrangements should include their requirements in the proposal budget. In the case of ongoing grants, grantees should inform the appropriate program officer at the National Science Foundation and ask for necessary changes in project budget allocations or, if required, supplemental funds.

An individual working on a research grant becomes a temporary employee of the grantee institution at which the principal investigator holds an appointment. The length of the employment, the stipend, and other arrangements with respect to employment become matters of individual negotiation between the arriving scientist from the smaller institution and the host institution.

Although no separate program exists for this activity, it has always been possible for Foundation grantees to involve small-college faculty in NSF research grants. This kind of participation is often a routine feature of research activity at the larger institutions. Such arrangements are encouraged within the framework of the Foundation's program to support scientific research projects. Each case is judged on its own research merits.

For More Information

Contact the appropriate Foundation program officer or the Research in Undergraduate Institutions Coordinator, NSF, Washington, D.C. 20550. (202) 357-7456.

NSF VISITING PROFESSORSHIPS FOR WOMEN

This program is designed to encourage the full use of the Nation's scientific and technical resources; it gives established women scientists and engineers opportunities to serve as visiting professors at academic institutions in the United States or its territories. There, in addition to research and teaching, they will be available to offer advice and mentorship for women at all levels, from undergraduate to faculty.

Eligibility

Women who hold doctorates in fields normally supported by NSF (or who have equivalent experience) and those with independent research experience in academic, industrial, or public sectors may apply to serve as visiting professors at universities or four-year colleges.

Deadlines

For consideration in the fiscal year 1985 competition, proposals must be submitted by November 15, 1984.

For More Information

An annual program announcement gives more information on preparing proposals. For a copy, contact the Program Director, Visiting Professorships for Women, National Science Foundation, Washington, D.C. 20550, (202) 357-7734.

RESEARCH OPPORTUNITIES FOR WOMEN (ROW)

This program provides opportunities for women scientists and engineers to undertake independent research. By supporting research grants for women who have not previously been principal investigators or who are reentering research careers, ROW responds to NSF's concern for the quality, distribution, and effectiveness of the human resource base in science and engineering.

Research projects will be supported up to a maximum period of 36 months. Proposals will be reviewed in accordance with the four standard evaluation criteria listed in *Grants for Scientific and Engineering Research* (NSF 83-57).

Eligibility

Women eligible to submit proposals are (1) those who have received their doctorates at least three years prior to the submission of the proposals to NSF and have not previously served as principal investigators under a Federal award for scientific or engineering research, or (2) those with doctorates whose research careers have been interrupted for at least two of the past five years and who have not served as principal investigators under a Federal award for scientific or engineering research since reentering their careers.

Deadlines

For consideration in the fiscal year 1985 competition, proposals must be postmarked by January 15, 1985.

For More Information

An annual program announcement (NSF 84-42) gives more information on preparing proposals. For a copy, contact the Program Director, Research Opportunities for Women, National Science Foundation, Washington, D.C. 20550, (202) 357-7734.

MINORITY RESEARCH INITIATION (MRI)

MRI is an integral part of the Foundation's overall effort to give greater access to scientific research support to minority groups that are underrepresented in the science and engineering career pool. Research projects will be supported up to a maximum period of five years, with support for years four and five contingent on the availability of funds and on research results that warrant further support. Funds may be used to defray the NSF share of the expense categories described in *Grants for Scientific and Engineering Research* (NSF 83-57). Research initiation grants are not renewable; followup proposals requesting continued support may be submitted to other Foundation programs but are not eligible under MRI.

Eligibility

The MRI program provides support for minority faculty members who are nationals of the United States and who wish to establish quality research efforts on their campuses, thereby increasing their ability to compete successfully for regular support from the Foundation and other sources. Individual minority scientists eligible to submit proposals are those with full-time status at colleges or universities in the United States that have academic programs in the sciences or engineering. Proposals may be submitted by any minority faculty member who has not received any previous Federal research support as a faculty member.

Deadlines

No specific deadlines or target dates apply to this program. Review and processing usually take from six to nine months.

For More Information

Contact the Program Director, Minority Research Initiation, National Science Foundation, Washington, D.C. 20550. (202) 357-7350.

RESEARCH IMPROVEMENT IN MINORITY INSTITUTIONS (RIMI)

Funds go to improve research environments at predominantly minority institutions. The program supports faculty research and the acquisition of research equipment, along with cooperative research projects among academic institutions and between those institutions and industry.

Eligibility

Proposals may be submitted by scientists and engineers who have full-time appointments at predominantly minority colleges and universities in the United States. These schools must have (a) graduate programs in science or (b) either graduate or undergraduate programs in engineering. An institution may submit only one RIMI proposal per year.

Deadline

December 15, 1984

For More Information

Contact the Program Director, Research Improvement in Minority Institutions, National Science Foundation, Washington, D.C. 20550. (202) 357-7350.

FACILITATION AWARDS FOR HANDICAPPED SCIENTISTS AND ENGINEERS (FAH)

These awards for handicapped scientists and engineers respond to NSF's long-standing policy of encouraging physically disabled scientists and engineers to participate fully in NSF programs.

The purposes of the FAH are: (1) to reduce or remove barriers to participation in research and training by physically disabled individuals by providing special equipment and assistance under NSF awards, and (2) to encourage physically disabled individuals to pursue careers in science and engineering by stimulating the development and demonstration of special equipment that facilitates work performance.

The need for special equipment or assistance must be specific to the research project for which it is requested. Support will not be given for equipment or assistance that compensates in a general way for a handicapping condition.

Requests for support may be included in regular research proposals submitted to any NSF program office or in requests for supplements to existing grants. Funds will be provided only in conjunction with awards resulting from the regular NSF competition. FAH requests may be reviewed separately for reasonableness and appropriateness by individuals knowledgeable about both the research discipline and the handicapping condition.

Handicapped researchers eligible for FAH include principal investigators, other senior personnel, postdoctoral associates, other professionals, and graduate and undergraduate students.

For More Information

A brochure describing this program is available from the FAH Coordinator, Division of Research Initiation and Improvement, National Science Foundation, Washington, D.C. 20550, (202) 357-7552.

The FAH Coordinator will respond to general inquiries. Questions about a specific program should go to the appropriate NSF program officer.

INTERGOVERNMENTAL SCIENCE AND TECHNOLOGY

This program fosters the development and use of scientific and technical resources that respond to needs addressed by State and local governments, with emphasis on R&D-based business and economic development. Current support is for program assessment, program development, and networking activities. Collectively, these efforts are designed to capitalize on NSF's activities and experience in intergovernmental science and technology, to stress the replication of successful institutional arrangements, to focus on critical issues of common concern to State and local governments, and to strengthen the resource base for scientific and engineering research itself.

For More Information

Due to the nature of this program and the requirements of Executive Order 12372, applicants are encouraged to contact program staff for guidance. Send inquiries to the Director, Intergovernmental S&T Program, National Science Foundation, Washington, D.C. 20550. (202) 357-7560.

ETHICS AND VALUES IN SCIENCE AND TECHNOLOGY (EVIST)

This program supports research and related activities to answer the question: How can the ethical problems and value conflicts associated with current scientific and engineering activities be better understood and more effectively resolved by scientists and engineers, scholars in the humanities, persons making science policy, and members of affected groups? Projects focus on the activities of scientists (including social scientists) and engineers in areas of social or professional concern. The aim is to clarify the ethical implications or value assumptions of those activities and to help formulate sound policy. The program makes awards for research projects, professional development activities, and dissertation support.

Deadlines

Preliminary proposals are required and may be submitted at any time. Formal proposals, submitted after the staff has commented on preliminary proposals, are considered twice a year. Deadlines are February 1 and August 1.

Eligibility

Colleges, universities, laboratories, industrial firms, citizen groups, State and local governments, professional associations, and other profit and nonprofit organizations.

For More Information

Contact Ethics and Values in Science and Technology, Program Director, National Science Foundation, Washington, D.C., 20550. (202) 357-7552. Ask for NSF brochure 83-62.

(See "Quick Reference Chart," which summarizes information in this section.)

The Foundation encourages and supports U.S. participation in international science and engineering activities that promise significant benefit to the U.S. research effort.

It is Foundation policy to foster the exchange of information among scientists in the United States and foreign countries, initiate and support scientific activities in matters relating to international cooperation, give U.S. scientists opportunities for scientific collaboration in developing countries, and provide support to U.S. institutions for research done abroad.

Programs described in this section are designed to carry out the above policies. They are coordinated or managed by the Division of International Programs (INT) and complement other Foundation activities in support of scientific research.

INT welcomes inquiries about any of the programs listed and encourages U.S. scientists and engineers to discuss their plans with the staff of this division.

BILATERAL COOPERATIVE SCIENCE ACTIVITIES

The programs described here focus on cooperation with particular countries generally categorized as (1) industrial countries of Western Europe, East Asia, and Oceania; (2) China and countries of Eastern Europe; and (3) countries that are not well developed industrially.

Common Features

The programs are designed to support the work of U.S. scientists cooperating with those of other countries in research and related activities. The programs have the following general goals: to stimulate scientific progress by bringing U.S. scientists and engineers together with counterparts from other countries or traditions but with similar scientific interests; to enhance scientific knowledge in priority areas of mutual interest; to offer opportunities for U.S. scientists to participate in projects aimed at improving the scientific infrastructure in developing countries; to assist U.S. and foreign scientists in efforts to share access to important or unique research facilities; and to improve mutual understanding with other nations and cultures.

The NSF programs described below are not intended to affect other arrangements for binational scientific cooperation.

Except as described below for individual programs, all have the following characteristics:

Types of Activities

Three types of activities may receive support: (1) cooperative research projects designed and conducted jointly by principal investigators from the United States and the foreign country; (2) research-oriented seminars or workshops (meetings of small groups of researchers from the United States and from the foreign country) to exchange infor-

International Cooperative Scientific Activities

DIVISION OF INTERNATIONAL PROGRAMS
QUICK REFERENCE CHART

Country or Region	Phone (202)	Program Announcement	Coop. Research	Seminars, Workshops	Sci. Visits
Argentina	357-9563	NSF 80-52	D	D	A
Australia	357-9700	NSF 81-49	D	D	N
Austria	357-9700	NSF 83-73	D	D	D
Belgium	357-7554	NSF 83-73	A	A	A
Brazil	357-9563	NSF 80-52	D	D	A
Bulgaria	357-9516	NSF 80-46	A	A	A
China	357-7393	NSF 82-50	A	A	N
Finland	357-7554	NSF 83-73	D	D	D
France	357-7554	NSF 83-73	D	D	D
Germany (FRG)	357-9700	NSF 83-73	D	D	D
Hungary	357-9516	NSF 80-46	A	A	A
India	357-9402	NSF 82-86	A	A	D
Italy	357-7554	NSF 83-73	D	D	D
Japan (1)	357-9558	NSF 81-58	D	D	A
Korea (ROK)	357-9537	NSF 83-50	D	N	D
Mexico	357-9563	NSF 80-52	D	D	A
New Zealand	357-9700	NSF 81-50	D	D	A
Pakistan	357-9402	NSF 80-49	A	A	D
Romania	357-9516	NSF 80-46	A	A	A
Spain	357-9550	NSF 84-10	D	D	D
Sweden	357-7554	NSF 83-73	A	A	A
Switzerland	357-9700	NSF 83-73	D	D	D
United Kingdom	357-7554	NSF 83-73	D	D	D
Venezuela	357-9563	NSF 80-52	D	D	A
Africa Regional	357-9550	NSF 84-26	D	D	D
East Asia Regional	357-9537	NSF 83-50	D	D	D
Latin America Regional	357-9563	NSF 80-52	D	D	A
South Asia Regional	357-9402	In press	A	A	A
Western Europe Regional	357-9700	NSF 83-73	D	D	D
Science in Developing Countries (2)	357-9537	NSF 83-58	N	A	N
U.S.-Israel BSF (3)	357-7613	——	D	N	N

Notes: D = Please see text for proposal deadlines. A = Proposals may be submitted at any time. N = This category of support is not offered. (1) U.S.-Japan Cooperative Science Program. For U.S.-Japan Program of Cooperation in Photoconversion and Photosynthesis, see text and refer to the publication NSF 83-112. (2) See text for categories of support. (3) This is not an NSF program; announcement available on request.

mation, review the current status of a specific field of science or engineering, and plan cooperative research; (3) scientific visits for planning cooperative activities or for research.

Eligibility

Eligible areas of research and related efforts are listed in the introduction to this publication. In several international programs, NSF and its counterpart agency in the foreign country have agreed on program priorities that fall within the eligible areas.

U.S. universities and colleges, professional societies, research institutes, and individual scientists and agencies affiliated with such organizations may apply for support. Principal investigators/project directors should be U.S. scientists with professional experience equivalent to at least five years of postdoctoral scientific work. A U.S. scientist is a member of the U.S. scientific community who performs scientific work chiefly in the United States.

Funding

In most programs, each country pays for the costs of its participation. Through the programs described below, NSF usually provides only the supplemental support required to introduce an international element or broaden the international character of a research effort. Primary funding for a U.S.-based effort may come from any U.S. funding source, including but not confined to the domestic research support programs at NSF.

Binational Approval

For cooperative research and seminars, a U.S. applicant sends a proposal to NSF; the cooperating scientist in the foreign country usually submits a corresponding proposal at the same time to the appropriate agency in that country. In formal bilateral programs, activities typically require approval of both NSF and its foreign counterpart agency before funding in either country.

Deadlines

Some programs have deadlines for receipt of applications at NSF; where deadlines are not stated, proposals may be submitted at any time. Processing time for proposals for cooperative research, seminars, and long-term scientific visits averages 7 months, but seminar organizers often need to submit their proposals up to 12 months in advance for planning purposes. Proposals for short-term scientific visits (visits of a month or so) should be received at NSF at least 4 months before desired departure date.

For More Information

U.S. scientists may obtain further information about any international program, including program announcements (i.e., guidelines for the preparation of proposals), by writing to the particular program in care of the Division of International Programs, National Science Foundation, Washington, D.C. 20550.

Programs encourage, but do not require, preliminary inquiries from scientists who intend to apply for support.

Formal Bilateral Programs

The "Common Features" described above apply to the formal bilateral programs. Exceptions are noted below:

U.S.-Argentina Cooperative Science Program

Deadlines for cooperative research or seminar proposals: May 1 and November 1. Scientific visits may not exceed one month.

U.S.-Australia Cooperative Science Program

Types of projects: cooperative research, seminars/workshops.
Proposal deadlines:

October 1 for seminars and cooperative research projects that involve exchange visits and have effective dates the following year between July 1 and December 31; April 1 for all research visits by U.S. scientists to Australia that will begin in the following calendar year and for all other proposals with requested effective dates of January 1 to June 30.

Government scientists and their organizations may participate but generally must provide their own funds. U.S. scientists involved as principal

investigators/project directors must have a doctoral degree or its equivalent.

U.S.-Austria Cooperative Science Program

Deadlines for proposals: March 1 and September 15. Types of projects: cooperative research, joint seminars, and long-term research visits.

U.S.-Belgium Cooperative Science Program

Types of projects: cooperative research, seminars, and long-term research visits.

U.S.-Brazil Cooperative Science Program

Deadlines for cooperative research or seminar proposals: May 1 and November 1. Scientific visits may not exceed one month.

U.S.-Bulgaria Cooperative Science Program

See "Common Features," above.

U.S.-China Cooperative Science Program

Types of projects: cooperative research; research-oriented seminars. Eligible fields include archeology; astronomy; chemistry of natural products; geophysics and geochemistry; engineering sciences, including heat transfer, fluid mechanics, solid mechanics, and structural mechanics (and applied mathematics related to those areas); basic and theoretical information sciences (e.g., artificial intelligence, pattern recognition), international studies (seminars preferred); linguistics; materials science (ceramics, metallurgy, and polymers); plant sciences, including research on insects harmful to plants; and systems analysis (operations research and decision sciences).

Research visits included in cooperative projects are limited in duration to six months each way in a given year. Appropriate counterpart institutions in China are the Institutes of the Chinese Academies of Science and Social Sciences and universities under the Ministry of Education.

U.S.-Finland Cooperative Science Program

Deadlines for proposals: March 1 and September 1. Types of projects: cooperative research, seminars, long-term research visits.

U.S.-France Cooperative Science Program

Types of projects: cooperative research, seminars, exchange of scientists. The last project applies to U.S. citizens or nationals who have earned a doctoral degree or its equivalent before beginning the exchange visit. A portion of the awards is reserved for junior applicants who have earned the degree within five years of starting the visit. Appropriate hosts are French institutions of higher education; government research institutes, laboratories, or centers; and privately sponsored institutes. The period of the visit may be 4 to 15 months.

Applications deadlines: May 1 for cooperative research projects and joint seminars; October 1 for exchange visits starting between May 1 and December 31 of the next calendar year.

U.S.-Federal Republic of Germany Cooperative Science Program

Deadlines for proposals: March 1 and September 1. Types of projects: cooperative research, joint seminars, long-term research visits.

U.S.-Hungary Cooperative Science Program

See "Common Features," above.

U.S.-India Cooperative Science Program

Types of projects: cooperative research, guest scientists, group travel to international conferences and workshops, individual travel to finalize formal cooperative research proposals or to engage in research, and an exchange of senior scientists. Processing time for cooperative projects and scientific visits: 8 months after foreign government approval received at NSF. For conferences, 8 to 12 months in advance of the conference.

This program uses foreign currencies that the Department of the Treasury has determined to be in excess of the established requirements of the U.S. Government. U.S. applicants also may apply for supplemental dollar sup-

port where necessary to enhance the benefits of U.S. participation. Indian organizations may receive grants directly from NSF; they apply through their Government.

Individual travel application deadlines: September 1 for travel starting between January 1 and March 31; December 1 for travel starting between April 1 and June 30; March 1 for travel starting between July 1 and September 30; and June 1 for travel starting between October 1 and December 31.

The exchange of senior scientists includes short-term visits. NSF pays international transportation costs of U.S. participants; within India their expenses are covered by the Council of Scientific and Industrial Research and the institutional host. Deadlines: March 15 for travel starting November 15 or later; September 15 for travel starting May 15 or later.

U.S.-Italy Cooperative Science Program

Deadline for proposals: May 1. Types of projects: cooperative research, joint seminars, long-term scientific visits.

U.S.-Japan Cooperative Science Program

Deadline: June 1 for cooperative research projects that will start during the following calendar year and for seminars that will take place during the 12-month period starting April 1 the following year. Proposals for long-term visits of 6 to 12 months may be submitted at any time.

U.S.-Japan Program of Cooperation in Photoconversion and Photosynthesis

Deadline for proposals for research visits: January 15. Both short- and long-term visits, from 3 to 12 months, are supported. Proposals for two-week project development visits are accepted throughout the year.

U.S.-Republic of Korea Cooperative Science Program

See "Common Features," above. Deadlines for cooperative research and long-term visits are January 1 and July 1.

U.S.-Mexico Cooperative Science Program

Deadlines for cooperative research or seminar proposals: May 1 and November 1. Scientific visits may not exceed one month.

U.S.-New Zealand Cooperative Science Program

The areas of science coordinated by NSF exclude energy; energy-related activities under this program are handled by the Director of International Affairs, Office of Technical Cooperation, U.S. Department of Energy, Washington, D.C. 20585. Types of projects: cooperative research; seminars or workshops; and short-term (up to three weeks) visits to develop projects in physical oceanography, marine geology and geophysics, and marine biology, especially fisheries. For short-term development visits, proposals should be submitted at least four months before desired departure date. Other proposals must meet the following deadlines: October 1 for projects with requested effective dates falling between July 1 and December 31 of the next year; April 1 for requested effective dates from January 1 to June 30. U.S. scientists participating as principal investigators/project directors must have a doctoral degree or its equivalent.

U.S.-Pakistan Cooperative Science Program

Details are similar to those found under "U.S.-India Cooperative Science Program," above, excluding a separate program for exchange of senior scientists.

U.S.-Romania Cooperative Science Program

See "Common Features," above.

U.S.-Spain Cooperative Program in Basic Sciences

Types of projects: cooperative research, joint workshops, exchanges of senior scientists, and short-term research visits. Proposals are submitted in parallel by U.S. and Spanish scientists to NSF and the Spanish Ministry of Education and Science (MEC), respectively.

Grants are made to both sides and administered by the U.S.—Spain Joint Committee for Scien-

tific and Technological Cooperation, upon joint recommendation by NSF and MEC. Research support offered under these programs is supplemental.

Deadlines for receipt of proposals to both NSF and MEC are March 31 and September 15. Grants are made approximately seven months after submission deadline.

U.S.-Sweden Cooperative Science Program

Deadlines for proposals: March 1 and September 15. Types of projects: cooperative research, seminars, long-term research visits.

U.S.-Switzerland Cooperative Science Program

Deadline: May 1. Types of projects: cooperative research, joint seminars, long-term research visits. Application forms for International Postdoctoral Exchanges to be awarded by the Swiss National Science Foundation must be received at NSF by October 1 of the calendar year before the award.

U.S.-United Kingdom Cooperative Science Program

Deadline for proposals: July 1. Types of projects: cooperative research, joint seminars, long-term research visits.

U.S.-Venezuela Cooperative Science Program

Deadlines for cooperative research or seminar proposals: May 1 and November 1. Scientific visits may not exceed one month.

Regional Programs

In addition to activities under the formal bilateral arrangements named in the preceding section, NSF supports U.S. participation in projects under less formal arrangements with countries in the four geographic regions named in this section.

The "Common Features" described above apply to the regional programs. Exceptions are noted below:

Sub-Saharan Africa (SSA)

Target dates for proposals: September 1 and March 1. Types of projects: cooperative research; short- and long-term visits; conferences, seminars, and workshops (preferably in SSA region); and doctoral dissertation (for students who are nationals of SSA countries and enrolled in doctoral programs at U.S. universities). Targeted countries are listed in the "Science in Developing Countries Program" section. Processing time for proposals in all categories averages seven months.

East Asia

Eligible countries: Indonesia, Malaysia, The Philippines, Singapore, Thailand. Target date for proposals: March 1. For long-term visits, cooperative research, and seminars or workshops with Philippine scientists and engineers, the annual deadline of July 1 has replaced the target date. Processing time for proposals in all categories averages seven months.

Latin America

Deadlines for cooperative research or seminar proposals: May 1 and November 1. Scientific visits may not exceed one month.

South Asia

Processing time for proposals in all categories averages seven months.

Western Europe

Informal arrangements for cooperation exist with Denmark, The Netherlands, and Norway; deadlines for submission of proposals for cooperative activities with scientists in these countries are March 1 and September 15. In addition, cooperative projects with scientists in other Western European countries, as well as seminars involving more than one country, can be supported; proposals for these activities may be submitted at anytime.

SCIENCE IN DEVELOPING COUNTRIES PROGRAM

The programs described in the previous sections have as their main purpose the improvement and international exchange of scientific knowledge. The Science in Developing Countries (SDC) program makes small grants ($20,000 or less) for the life of the project that serve this purpose but are primarily directed toward improving the scientific infrastructure of developing countries.

Countries Included in SDC Program

A list of the low- and middle-income developing countries of Africa, Asia, and Latin America (including the Caribbean) which may participate in the program follows.

North Africa and Turkey

Algeria, Egypt, Morocco, Tunisia, Turkey.

Sub-Saharan Africa

Benin, Botswana, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Djibouti, Equatorial Guinea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Madagascar, Mali, Malawi, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Seychelles, Senegal, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Togo, Uganda, Upper Volta, Zaire, Zambia, and Zimbabwe.

East Asia

Indonesia, Korea,* Malaysia, Philippines, Singapore, and Thailand.

South Asia

Bangladesh, Bhutan, Burma, India, Nepal, Pakistan, and Sri Lanka.

West Asia

Jordan, Lebanon, Syria, and Yemen Arab Republic.

Latin America

Argentina,* Belize, Bolivia, Brazil,* Colombia, Costa Rica, Chile, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico,* Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, and Venezuela.*

Caribbean

Antigua and Barbuda, Bahamas, Barbados, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Saint Lucia, Saint Vincent and the Grenadines, and Trinidad and Tobago.

*Projects in these countries are limited to workshops in which the majority of the participants come from other countries of the region.

Many mutual benefits result from cooperative activities with developing countries. Scientists and engineers from cooperating institutions abroad obtain the advantage of collegial relationships with U.S. scientists and engineers in specific projects that address priority problems of mutual interest. Participating U.S. scientists and engineers increase their opportunities to engage in research and teaching. Projects that are relevant to the developing country and contribute to its capacity to train and use scientists and engineers are especially sought.

Grants are made to U.S. institutions, but projects often involve activities at a foreign site. When appropriate, project budgets include partial payment of support costs of developing-country counterparts. Counterpart scientists and institutions participate in both planning and implementation of project activities. The degree of local enthusiasm, including the allocation of staff and financial support, are important considerations in making awards. Mutual benefits lasting beyond the term of support are expected.

Types of Projects

The following categories of awards are made to U.S. institutions that sponsor SDC projects:

- Research/participation grants to support (a) the participation of U.S. scientists or engineers in a research or science education project in an eligible developing country, (b) the participation by

scientists or engineers from an eligible developing country in an appropriate U.S.-based project, or (c) a combination of these. This program provides only supplemental costs related to collaboration; primary research costs are not provided.

• Conference grants to support these national, regional, and international activities: (a) seminars that are research oriented and focused on developing-country problems; (b) workshops concerned with the planning and initiation of cooperative research activities; or (c) colloquia at which scientists or engineers involved with state-of-the-art research explore the application of science and technology to development problems.

• Dissertation improvement grants for the incremental support of developing-country graduate students who are enrolled at U.S. universities and qualified to undertake a dissertation research project. Among the costs covered are those for field equipment and supplies, and for travel to and from research sites. No stipend, tuition, fees, or indirect costs are provided. Only projects related to a developing-country problem and approved by a U.S. research advisor are considered for support.

In addition to the support of new projects in this program, projects that currently are funded from other sources but also meet SDC guidelines may qualify for supplemental support under this program.

Eligibility

Under the SDC program, NSF will consider proposals from universities or colleges; nonprofit, nonacademic research institutions; and private for-profit organizations. All prospective principal investigators (PIs) must be professionally qualified through training and work experience and be employed by a U.S. institution. Each proposal must identify a host-country counterpart scientist or engineer and a counterpart institution. Such institutions may be local, regional, national, or international in character. Projects may have multiple sites and may involve more than one foreign institution.

Deadlines

Target dates for receipt of proposals are September 1 and March 1. However, proposals may be submitted at any time. Processing time averages seven months.

For More Information

See "For More Information," under the section on bilateral cooperative activities.

JOINT FUNDS

The programs described in this section should not be confused with National Science Foundation programs. Consequently, institutions and investigators should be aware that standard NSF proposal and award guidelines and procedures do not apply.

UNITED STATES-ISRAEL BINATIONAL SCIENCE FOUNDATION

An agreement signed by the two governments in 1972 established a program of cooperative scientific research and related activities to be conducted principally in Israel, to be financed with Israeli currency, and to involve scientists and institutions of the United States and Israel. Activities must be of mutual interest to both countries.

The BSF office is located in Jerusalem, Israel. NSF and other U.S. Government agencies distribute information about BSF programs to U.S. scientists and organizations. The interests and activities of all scientific agencies of the U.S. Government in BSF are coordinated through the U.S. Department of State Bureau of Oceans and International Environmental and Scientific Affairs.

Cooperative Research Projects

The areas of research supported by BSF are health sciences, natural sciences, energy, and social and behavioral sciences. NSF encourages U.S. scientists to submit to BSF joint proposals of high quality that complement or otherwise relate to research supported under NSF programs. Send proposals directly to U.S.-Israel Binational Science Foundation, P.O. Box 7677, Jerusalem 91076, Israel.

Proposals judged by BSF to be meritorious are referred to the U.S. Government for comment before they are funded.

Deadlines

Deadline for receipt of proposals in Jerusalem is November 15 each year. Awards are made the following August.

For More Information

Program announcements and application forms may be requested by U.S. scientists working in research fields of interest to the National Science Foundation. Requests may be addressed to the Division of International Programs, National Science Foundation, Washington, D.C. 20550.

U.S.-YUGOSLAV JOINT BOARD FOR SCIENTIFIC AND TECHNOLOGICAL COOPERATION

Established in 1973 by an agreement between the two governments, the Board supports cooperation in science and technology between researchers of both countries. The National Science Foundation is one of several U.S. Government agencies that participate in the program; NSF reviews research proposals in its sphere of competence, makes funding recommendations to the Board, and monitors and aids project activities. Through its Bureau of Oceans and International Environmental and Scientific Affairs, the Department of State exercises overall policy management on the U.S. side. The State Department also provides the annual U.S. contribution to the Joint Fund, the source of financial support for all program activities.

Cooperative research proposals jointly prepared by U.S. and Yugoslav co-investigators are submitted to the Board by Yugoslav investigators. All financial aid under the program is provided in Yugoslav currency. No dollar support for research in the United States is available, but the Fund does support international transportation and subsistence expenses for U.S. investigators.

For More Information

U.S. scientists working in fields of interest to the National Science Foundation who wish to participate in this program must contact and work directly with potential Yugoslav co-investigators in preparing research proposals. U.S. scientists are encouraged to contact the Division of International Programs, National Science Foundation, Washington, D.C. 20550, for program guidelines and procedures.

Policy Research and Analysis

The Division of Policy Research and Analysis plays a significant role in meeting the need for government studies and analyses of science, technology, and economic policy issues. The objec-

tives of PRA programs are to:

- Improve the knowledge base for science, technology, and international economic policy by developing the tools for research and analysis. These tools include methodology development, testing, and application.
- Do policy analyses and assess options for policy decisions.
- Summarize and assess the available knowledge and data on specific issues.

These objectives are met by extramural research and internal studies under the following programs:

SCIENCE AND INNOVATION POLICY

This program analyzes the impacts of Federal and foreign government policies on U.S. science and industry and their contributions to national goals. Areas of interest are policy-relevant aspects of the determinants and impacts of (1) basic scientific research and (2) industrial research and development (R&D) and technological innovation. Typical research topics include:

- Effects of government measures (e.g., patents, research grant provisions, funding) on the contributions of scientific research to technology and the economy.
- Effects of government programs to strengthen the scientific infrastructure (e.g., trained personnel, research equipment) on the efficiency and effectiveness of U.S. research and innovation.
- Interactions among research funding sources (e.g., government versus private), approaches to research (e.g., government laboratories versus industry laboratories), and the quantity, quality, and character of scientific research results.
- Factors that influence the transmission of research results to the industrial sector and subsequent use of such results.
- Contributions of science, both university and industrial, to the Nation's economy.
- Effects of U.S. and foreign governments' policies to stimulate industrial R&D or otherwise to promote industrial development (either industry-specific or economy-wide) on industrial innovation and international economic competitiveness.
- Effects of regulations for technology (e.g., performance or health-related regulations, export controls) on U.S. and foreign industrial R&D and on international technology transactions.
- Factors affecting the degrees to which U.S. firms and foreign competitors exploit the existing world-wide stock of technology.
- Factors that affect the incentives for innovation.

POLICY SCIENCES

This program reviews, evaluates, and develops assessment and analysis techniques to improve public policy analysis and decisions on Federal scientific and technological issues. Examples of typical long-term issues:

- Development and evaluation of techniques to identify and create potential solutions to S&T public policy problems, such as risk management.
- Development and evaluation of better methods to use scientific, technical, and other databases in policy analysis and policymaking.
- Development and evaluation of (a) methods to use sparse data sets in policy analysis; (b) better ways to use scientific expertise in policymaking and (c) better value-of-information analysis techniques.
- The proper role of policy analysis, as compared to other approaches (e.g., public participation) in the public policymaking process.
- Relationships among policy design, implementation, and evaluation.
- The advantages and disadvantages of alternatives to regulation for managing technological risks.
- Development and evaluation of curricula that more effectively link policy science research results with the practice of policy analysis.

TECHNOLOGY AND RESOURCE POLICY

This program analyzes the relationships among government policies and specific technologies, industries, and natural resources. Examples of specific problems and questions include:

- Cost-effectiveness of current environmental monitoring pro-

grams and the relationship between monitoring technologies and environmental policies.

- Impacts of new biotechnology products on the environment, employment, industry, and mineral resources demands.
- Federal policy options using new communications, computer, and information technologies to enhance selection and dissemination of Government-generated data.
- Implications of new communications and information technologies on workforce training and education and appropriate Federal responses.
- Implications for Federal Government communications needs and uses arising from the new competitive communications environment.
- Ways for the Federal Government to transfer the products of R&D programs in specific technology areas (such as space and energy) to the private sector.

Eligibility

The work of the Division of Policy Research and Analysis is a cooperative effort involving a group of analysts within the NSF Directorate of Scientific, Technological, and International Affairs and a number of researchers from universities and other appropriate organizations.

Proposals that respond to the division's priorities are considered for awards, and profitmaking and other organizations are eligible to participate in the programs on the same basis as academic and nonprofit organizations.

Deadlines

Submit proposals at any time during the year. Allow about three to six months for review and decision. Letters of interest describing the proposed research are encouraged before submission of a formal proposal.

For More Information

Guidelines for submitting proposals are in the *Program Announcement and Solicitation* (NSF 84-8). For more information on the specific interests of the program areas, contact the Division of Policy Research and Analysis (indicate specific program of interest), National Science Foundation, Washington, D.C. 20550, (202) 357-9689.

Science Resources Studies

Activities of the Division of Science Resources Studies fulfill the legislative mandate of the National Science Foundation Act to ". . . provide a central clearinghouse for the collection, interpretation, and analysis of data on the availability of, and

the current and projected need for scientific and technical resources in the United States, and to provide a source of information for policy formulation by other agencies of the Federal Government. . . ." To carry out this mandate, the division performs:

- Periodic reviews of past and current national R&D funding and the supply and use of scientific and technical personnel; also short- and long-term projections about those resources.
- Identification and analysis of factors responsible for changes in the science and technology resource system; assessment of their effects.
- Collection, analysis, and dissemination of information on the economic, social, professional, and demographic characteristics of scientific and technical personnel.
- Compilation of information on U.S. and international science and technology resources and their characteristics and dynamics; development of means to measure science and technology output.

Most of the work of this division is performed internally or through contractual agreements with other Federal agencies and appropriate non-Federal organizations. Extramural studies and analyses of the division's extensive database are supported by awards under the Program for the Analysis of Science Resources: Personnel, Funding, Impacts, and Outputs (for which a program announcement is issued annually). Special studies are often supported through external awards. The three topic areas in which awards are made are as follows:

SCIENTIFIC AND TECHNICAL PERSONNEL

This program supports studies to give the factual information needed to track the training and distribution of the Nation's scientists and engineers. Specific areas of interest are the capability of the Nation's institutions of higher education to produce scientific and technical personnel, the current and future use of such personnel, and the changing characteristics of scientists and engineers.

FUNDING OF SCIENCE AND TECHNOLOGY

This program provides for the collection, analysis, and dissemination of information on the characteristics and patterns of funding for research and development and for other scientific and technological activities. Support is also given to develop modeling and simulation techniques that will improve the capability to project R&D funding.

MODELING AND SPECIAL SCIENCE AND TECHNOLOGY INDICATORS

This program supports studies on the dynamics of the science and technology resources complex. A major component is the development of special indicators, primarily of an output nature. This work, along with that of the other Science Resources Studies programs that deal primarily with inputs, provides the basis for the National Science Board's biennial *Science Indicators* publications; they are prepared by the SRS division. Also included are modeling and simulation activities. These are aimed at a better understanding of what causes changes in the distribution of human and financial resources for science and technology.

INTERNATIONAL S&T RESOURCES

This program supports the collection and analysis of data in the area of international S&T investments, activities, and capabilities. More extensive and more current information is sought on foreign science and technology inputs (e.g., funds, personnel, and equipment) outputs (e.g., patents, scientific literature, and innovations), and S&T impacts (e.g., productivity, royalties and fees, and R&D-intensive trade). Emphasis is on the collection and analysis of data on the large R&D-performing countries.

Eligibility

Unsolicited proposals are welcome and are considered for awards. Profitmaking and other organizations are eligible to participate in the division's programs on the same basis as academic

and nonprofit organizations.

Deadlines

In general, proposals may be submitted at any time during the year. Program announcements and requests for proposals are issued from time to time for special projects and studies in targeted areas; such solicitations specify deadlines for submission.

For More Information

The program announcement *Program for the Analysis of Science Resources: Personnel, Funding, Impacts, and Outputs* (NSF reprint 80-19) has guidelines for submitting proposals. Contact the Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550.

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OTHER ACTIVITIES

ADVANCED SCIENTIFIC COMPUTING

In FY 1984 the Foundation took a first step in a long-term effort to provide the scientific and engineering research community with significantly improved access to advanced large-scale computers. Three awards were made in response to a solicitation for proposals to provide Class VI or equivalently powerful computer services. Boeing Computer Services, Purdue University, and the University of Minnesota are providing a combined total of 5,150 hours of computing time on a Cray 1S, Cyber 205, and Cray 1A respectively.

The Foundation is encouraging unsolicited proposals from individuals or groups of investigators requesting access to these and other Class VI or equivalently powerful computer services. Proposals are expected to cover the full range of NSF-supported research activities and will determine the extent of need for these services. Proposals for access should go to the appropriate program officer for the particular research field.

In FY 1985, NSF has again solicited proposals from institutions capable of providing Class VI or equivalent computer services; these include academic institutions, not-for-profit and for-profit organizations, and Federally Funded Research and Development Centers (FFRDCs), or a combination of these organizations. Proposals from FFRDCs must be (1) consistent with the Federal sponsor's policies and (2) endorsed by the sponsoring Federal agency. Proposals under this solicitation were due to the Foundation by September 1, 1984.

A companion solicitation was issued requesting proposals to establish new advanced scientific computing centers that will enhance progress in many areas of science and engineering research and education. The Foundation expects to make one to three awards in FY 1985; the awards will normally be for a period of five years. To be considered for funding in FY 1985, proposals were due to the Foundation by October 1, 1984.

As a part of a goal to promote sharing of computational resources among all members of the scientific and engineering communities, NSF is developing plans for an integrated communications network; it would link the advanced scientific computing centers, universities, and other research centers. NSF also is developing companion programs to support local resources for access to advanced large-scale computers, technology demonstration centers, and projects enhancing software productivity.

DOCTORAL DISSERTATION RESEARCH IMPROVEMENT

The Foundation awards grants to improve the scientific quality of doctoral dissertation research. Awards are made to allow doctoral candidates opportunities for greater creativity in the gathering and analysis of data than would otherwise be possible. Grants are intended to cover research-related expenses. These include expenses for field equipment and supplies and for travel to and from research sites. These awards are *not* fellowships and no stipend is included. Support is not provided for everyday personal expenses of the doctoral student. However, the student may concurrently receive such support from other sources.

Dissertation proposals are judged on the basis of scientific content, importance, and originality. In addition, the doctoral candidate must show that the award will in fact improve the quality of the research.

Dissertation improvement awards are available only in certain disciplines. These include the social and behavioral sciences and certain of the biological, earth, atmospheric, and ocean sciences. No dissertation improvement awards are made in the mathematical and physical sciences, engineering, cellular and molecular biology, or physiology.

Eligibility/For More Information

Each division that administers these grants treats applications in a different way. Doctoral students who wish to apply for a dissertation improvement grant should write directly to the appropriate research division(s).

INFORMATION FOR SMALL BUSINESSES

NSF programs are of interest mainly to those small business concerns with strong capabilities in scientific or engineering research or in science-based innovative technology. Competition for awards from NSF is intense, and only high-quality research proposals are supported.

Most NSF funds are obligated through grants to support unsolicited research proposals judged scientifically meritorious in peer review. Note that these are grants, not procurements. Small firms may submit proposals under most of the programs identified in this *Guide*.

Although these programs mainly fund research in academic institutions, proposals from the commercial sector, including small research firms, are also supported.

Most NSF research awards to small businesses are made through the Small Business Innovation Research (SBIR) Program, described elsewhere in this publication. SBIR is conducted pursuant to the Small Business Innovation Development Act of 1982, P.L. 97-219. Grant proposals under this program are solicited by a formal SBIR program solicitation issued annually.

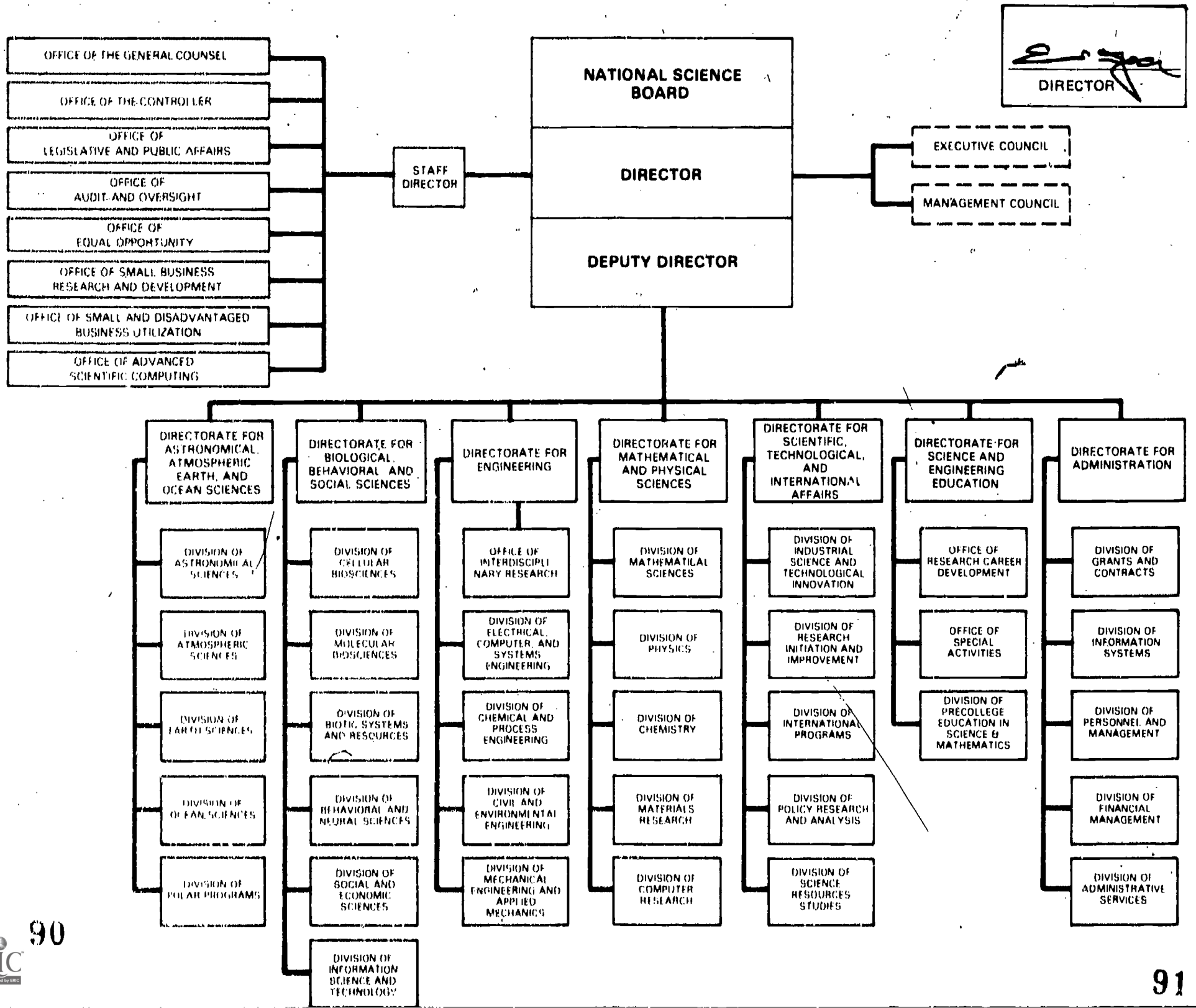
Compared to those at most Federal departments and agencies, procurement or contract opportunities at NSF are quite limited. The Foundation generally does not maintain bidders lists; competitive procurement opportunities are normally publicized in the *Commerce Business Daily*. The greatest opportunities for small companies are in the subcontracting activities of the NSF prime contractors that operate national centers or other major research facilities. Some of these facilities are identified elsewhere in this *Guide*.

NSF has two offices whose major functions are to provide information and serve as referral points for small businesses that are interested in the Foundation's research or procurement opportunities. Note that these offices do not administer any individual grant, contract, or procurement programs.

The Office of Small Business Research and Development offers to research and technology-based small firms information and guidance on NSF programs and research opportunities.

The Office of Small and Disadvantaged Business Utilization also provides information and guidance to small, minority and women-owned companies seeking procurement opportunities to provide NSF or its major prime contractors with goods or services.

The address for both these offices is Room 517, National Science Foundation, Washington, D.C. 20550. Telephone: (202) 357-7464.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